2008 INTEGRATED REPORT

CLEAN WATER ACT

Sections 303(d), 305(b) and 314

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Abbreviations and Acronyms

AAFB	Anderson Air Force Base
AOC	Area of Concern
BRAC	Base Realignment and Closure
CB	Construction Battalion
CCU	Consolidated Commission on Utilities
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CMS	Comprehensive Monitoring Strategy
CWA	Clean Water Act
CWAP	Clean Water Action Plan
CZMP	Coastal Zone Management Program
DAWR	Division of Aquatic Wildlife Resources
DMR	Discharge Monitoring Report
DoD, IRP	Department of Defense, Installation Restoration Program
ECP	Erosion Control Plan
EDB	Ethylene Dibromide
EPA	U.S. Environmental Protection Agency
FFCA	Federal Facilities Compliance Agreement
FSCMP	Fish and Shellfish Contaminant Monitoring Program
FIFRA	Federal Insecticide, Fungicides, and Rodenticide Act
GCA	Guam Code Annotated or Guam Coastal Assessment
GCMP	Guam Coastal Management Program
GEMAP	Guam Environment Monitoring and Assessment Program
GHS	Guam Hydrologic Survey
GIAA	Guam International Airport Authority
GIS	Geographic Information System
GWA	Guam Waterworks Authority
GWSA	Guam Wadeable Stream Assessment
GWMS	Guam Water Monitoring Strategy
GWQS	Guam Water Quality Standards
IR	Integrated Report
LUST	Leaking Underground Storage Tank
MCL	Maximum Contaminant Levels
MPWQAP	Marine Preserve Water Quality Assessment Program
MSWLF	Municipal Solid Waste Landfill Facility
NGL	Northern Guam Lens
NOAA	National Oceanic and Atmospheric Administration
NOV	Notice of Violation
NPDES	National Pollution Discharge Elimination System
NPL	National Priority List
NPS	National Park Service
NRCS	National Resources Conservation Service
NWI	National Wetlands Inventory

PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethene
PWSS	Public Water Supply System
RBMP	Recreational Beach Monitoring Program
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
SDWA	Safe Drinking Water Act
STMP	Status and Trends Monitoring Program
SWMS	Surface Water Monitoring Strategy
SVE	Soil Vapor Extraction
TCE	Trichloroethylene
TMDL	Total Maximum Daily Load
UIC	Underground Injection Control
UOG	University of Guam
USACE	United States Army Corps of Engineers
USGS	U.S. Geological Service
WERI	Water and Environmental Research Institute
WMP	Wetlands Monitoring Program
WPC	Watershed Planning Committee

Preface: An Overview of Guam

The Island of Guam is an unincorporated territory of the United States. It is the westernmost point of the United States, lying at latitude 13°28" N and longitude 144°45" E, or about 1,500 miles south of Tokyo, 1,730 miles east of Manila and 3,840 miles west and slightly south of Honolulu, Hawaii. Guam has an area of approximately 212 square miles (549 sq km) and measures about 30 miles (69 km) long with widths from 11 miles (25.3 km) in the south to 4 miles (9.2 km) in the center and 8 miles (18.4 km) in the north. **See Appendix A, Figure 1.**

The population projection for 2007 is approximately 173,456[1] people throughout the island except for certain military properties and the steep interior mountains of the South. The average population density is 730 per square mile; however, the density in the north is approximately 1,200 per square mile while the density in the south is 300 per square mile. Practically all residences are served by public/military community water supply systems, with a large number of single-family dwellings using individual septic tank/leaching field systems. Approximately one million tourists visit Guam annually, largely drawn by Guam's tropical climate and clean recreational marine and fresh waters.

Guam is the largest and southernmost of the Marianas Archipelago of islands and possesses the largest fresh water resources of these islands. Guam has a tropical oceanic climate, with warm temperatures and high humidity. Daily temperatures year around consist of highs in the middle eighties (degrees Fahrenheit) and daily lows in the low seventies. Relative humidity ranges between 65% and 75% in the afternoon to between 85% and 90% at night. Seasonal changes relate to amounts of rainfall. Wet season normally extends from July to November and dry season from January to May, with transitional periods between. Annual average rainfall varies from about 110 inches in the higher areas to about 80 inches along the shores. Periodic El Nino/ Southern Oscillation large-scale weather events trigger decreased rainfall and higher risks of typhoons on Guam in certain years. The largest measured El Nino event occurred in 1997-98. Guam is located in an area of the Western Pacific that experiences 38% of all the destructive tropical storms in the world. Torrential rains accompany frequently passing storms and typhoons.

Guam is divided into two distinct geological formations by a central fault line. The northern half is mainly a broad sloping limestone plateau, which is bordered by steep seaward cliffs and fringed by narrow coral reefs.

The southern half of the island is generally composed of eroded volcanic mountainous formations with numerous rivers and streams. These tropical streams and those of most Pacific islands are typically short in length and have very low mineral concentrations. These concentrations are similar island to island because the underlying geological formation is usually basalt. Another important characteristic of short tropical island

[1] Source: 2000 Census Population and Housing. Guam: International Programs Center, U.S. Census Bureau

streams is that photosynthesis by primary aquatic producers is not the dominant source of food. The major source of food for island stream ecosystems is usually the vegetation that falls into the streams from the plants along the banks as well as those that overhang the stream.

The larger fauna, fish, shrimp, eels, worms, and snails, found in island streams were originally marine organisms that adapted to freshwater conditions. Larvae from many of these organisms still develop in the ocean and return to fresh water streams as adults. But the insects and algae found in tropical island streams are truly freshwater organisms, unique to the islands. Also many of the freshwater fauna are morphologically adapted for climbing and can migrate through all the reaches of the stream, even up waterfalls.

The entire island of Guam is classified as a coastal zone consisting of 20 watersheds. It is surrounded by 116.5 miles of shoreline divided into three distinct classifications: rocky coastline, sandy beaches, and mangrove mud flats. The rocky coastline classification surrounds the northern end of the island with a few isolated stretches in the south. It is approximately 72.5 miles in length or 62% of the total shoreline. Sandy beaches are scattered intermittently around the island and comprises 35.9 miles of shoreline or 31% of the total. The remaining 8.1 miles or 7% of the total shoreline are classified as mangrove mud flats and are centered mainly within Apra Harbor and Merizo. There are also approximately 14.2 square miles of coral reefs, 0.55 square miles of seagrass beds, 1.43 square miles of estuarine systems, and 21.73 square miles of marine bays.

Shallow fringing coral reefs with outer slopes and margins supporting live coral colonies surround most of Guam. The bordering fringing reefs in the south are broader than in the north. The width of these reefs ranges from very narrow benches (as narrow as 10 to 20 feet) on the northeastern coast, to broad reef flats forming the popular recreational and fishing areas in Tumon, Hagåtña, Agat, and Asan Bays and on the shore side of Cocos Lagoon. These reefs are extremely valuable in terms of marine life, aesthetics, food supply, recreation and protection of Guam's highly erodible shorelines from storm waves, currents, and tsunamis. Two large barrier reef systems occur at Cocos Lagoon and at Apra Harbor. Cocos Island Lagoon and its reefs form an atoll-like environment about four square miles in area, with a greatest lagoon depth of approximately 40 feet. The uplifted limestone plateau of Orote, Cabras Island and a large artificial breakwater, which was built on a shallow reef platform and adjacent submerged bank, bound the much deeper lagoon of Apra Harbor, with depths over 120 feet.

Seaward, the reef front slopes gently downward to a terrace at a depth of approximately 20-30 feet. Here, submarine channels cut the surface of the reef. These channels are lined with living corals and contain the richest fauna (animal life) to be found in any reef zone. The submarine terrace slopes gently downward to a depth of 30-50 feet. This zone supports many scattered colonies of coral.

The North Equatorial Current, driven by northeast trade winds, generally sets in a western direction around Guam with a velocity of 0.5 to 1.0 knot. Guam tides are semi-

diurnal with a mean range of 1.6 feet and diurnal range of 2.3 feet. Extreme predicted tide range is about 3.5 feet.

EXECUTIVE SUMMARY

1.0 Overall Surface Water and Ground Water Quality

The Guam Water Monitoring Strategy (GWMS) was significantly revised during fiscal years 2002-2004. It was submitted to EPA as the Comprehensive Monitoring Strategy (CMS) for the island of Guam late in 2005 and initially implemented that fiscal year.

Sufficient data and/or information were not available to make use support determinations for all of the island's waterbody types for the 2006-2007 reporting period.

Guam's CWA section 303(d) list of impaired and threatened waters is presented in Table **23**.

1.1 Marine Waters

Guam's marine waters were generally "good". Water in this category must be of sufficient quality to allow for the propagation and survival of marine organisms, particularly shellfish and other similarly harvested aquatic organisms, corals and other reef-related resources, and whole body contact recreation. Other important intended uses include mariculture activities, aesthetic enjoyment and related activities (Guam Water Quality Standards, GWQS).

No marine bays **(see Table 21-A)** were assessed during the reporting period. The marine bays on the 2008 303(d) list were categorized impaired as a result of assessment data for prior years.[2] The reasons for impairment are noted.

IMPAIRED MARINE BAYS

Waterbody Name	Reason for Impairment
Tumon Bay	Waters not meeting designated uses
Pago Bay	>10% of samples exceed GWQS
Agat Bay	Fish Advisory
Apra Harbor	Fish Advisory
Cocos Lagoon	Fish Advisory

[2] Cocos Lagoon newly added to the 303(d) list. Remaining water bodies carried over from 2006.

Guam coastal/recreational waters (see **Table 21**) were assessed only for the Goal "Protect and Enhance Public Health" and the Use "Primary Contact/Swimming and Secondary Contact".

- In 2006, Guam EPA monitored 9.37 of the total 43.65 shoreline miles of Guam coastal waters. Of the shoreline miles monitored, 0.69 miles fully supported and attained GWQS for the designated uses; and 8.68 miles did not support or attain GWQS.

- In 2007, the Agency monitored 9.37 of the total 43.65 shoreline miles of coastal waters. Of the shoreline miles monitored, 0.46 miles fully supported and attained GWQS for the designated uses; and 8.91 miles did not support or attain GWQS.[3]

Swimming advisories are issued based upon either an instantaneous concentration of 104 MPN/100mL or a geometric mean concentration of 35 MPN/100mL, over a five week period. During 2006, 604 swimming advisories were issued. During 2007, 601 swimming advisories were issued and West Hagatna Bay was closed for 365 days due to a sewage leak in the effluent pipe from the Hagatna Sewage Treatment Plant. **(Refer to Tables B7a-c and B8a-d, Appendix B).**

1.2 Fresh Water

Fena Reservoir

The only inland body of water on Guam is Fena Reservoir, constructed by the Navy as a drinking water supply. "The Fena Reservoir is the primary source of water for the U.S. Navy Water System and is supplemented by the Almagosa and Bona Springs. Water from the reservoir and springs is processed at the Navy Water Treatment Plant before distribution. The system satisfied all monitoring requirements set forth by the National Primary Drinking Water Standards,..."[4]

Rivers and Streams

No assessment of Rivers and Streams was conducted during 2006 or 2007. **Table 20** provides information about the surface waters included in the Agency's monitoring strategy. The following waters (from Table 20) are impaired and on Guam's 2008 303(d) list as a result of previous assessment data : Hagatna River (GUAGRA-3), Agana Swamp (GUGI-1B), Lonfit River segments GUPGRL-1-51B and GUPGRL-2, Pago River segments GUPGRP-1 and GUPGRP-2, and Landfill Leachate Stream (GUPGRL-0). Table 23 identifies the basis for impairment and the pollutants for these impaired waters. The Ugum River, a primary source of drinking water in southern Guam, is also an impaired fresh water body due to turbidity[5].

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[3] See Appendix B, Table B11: 2008 Individual Use Support Summary for Coastal/Recreational Waters (Shoreline Miles)

[4] 2006 & 2007 Annual Water Quality Report, Department of the Navy, Commander U.S. Naval Forces Marianas

[5] Ugum River removed from the 303(d) list because a TMDL was developed and approved in 2006.

Northern Guam Lens (NGL) – Guam Sole Source Aquifer
The overall water quality of the NGL is good. However, it is significantly vulnerable to contaminants, including chloride contamination induced from over pumping of water supply wells, and groundwater well influence by surface water or raw sewage from leaking sewer pumps or sewer pipes. Because of its designation as Guam's Sole Source Aquifer and because of the magnitude of incidences observed in which the levels of pollutants (Bacteria, Nutrients, Chlorides, and Toxic Contaminants) exceeded GWQS, action to restore, protect, and sustain the NGL remains a high priority.

In March 2007 Guam EPA hosted a groundwater workshop to initiate a water quality study on the Northern Guam Lens. The study expects to determine if wells, the aquifer and or sub-basins qualify as "Groundwater under the direct influence of surface water" or GWUDI. GWUDI refers to groundwater where water at the surface, like rainwater, can wash pollutants down to a well without any natural purification. GWUDI wells need additional treatment to make the water safe. The study is on-going.

2.0 Causes and Sources of Water Quality Impairments

The causes and sources of water quality impairments are discussed in the following sections.

2.1 Marine Waters

Applicable categories of causes or stressors for impaired marine bays or recreational beaches are respectively listed in **Tables B5b. and B5c., Appendix B**.

For Marine Bays these categories include pesticides, PCBs, dioxins, nutrients, pathogen indicators, and dissolved oxygen.

The pollutant causing recreational beach impairments was **enterococcus**, a pathogen indicator. In 2006, 8.68 shoreline miles of recreational beaches were impaired by these bacteria. In 2007, these same stressors caused 8.91 shoreline miles of recreational beaches to be impaired.

Of the various source categories listed in **Tables B6b. or B6c.** for recreational beaches, suspected source categories include municipal point sources, combined sewer overflows, agriculture, urban runoff/storm sewers, contaminated sediments, and groundwater seeps/springs.

2.2 Fresh Waters

Of the one-hundred one (101) river/stream assessment units, eighty-nine (89) were not assessed or reported as waters with insufficient available data to make a use support determination – Category 3. The remaining twelve (12) assessment units are categorized impaired because of assessment data reported from prior years.

The Ugum River, 21.58 miles, is impaired but a Sediment TMDL has been approved to bring the water body into compliance with GWQS. It was removed from the 303(d) list in 2006.

The following surface waters are impaired and on the 2008 303(d) list:

Lonfit River segment	GUPGRL-1-51B	3.79 miles
Lonfit River segment	GUPGRL-2	1.07 miles
Landfill Leachate Stream	GUPGRL-0	0.05 miles
Pago River segment	GUPGRP-1	0.1 miles
Pago River segment	GUPGRP-2	4.73 miles
Agana Swamp	GUG1-B	6.40 acres
Hagatna River	GUAGRA-3	0.52 miles

The pollutants for these waters are listed in **Table 23.**

Table B9., Appendix B lists the ten priority sources of groundwater contamination and the respective contaminants associated with each source are:

- **Agricultural Activities**:
  - Animal feed lots --- nitrates, bacteria
  - Fertilizer applications --- nitrate
  - Pesticide applications --- organic & inorganic pesticides
- **Storage and Treatment Activities**:
  - Underground storage tanks --- petroleum compounds
- **Disposal Activities**:
  - Landfills --- inorganic & organic pesticides, halogenated solvents, petroleum compounds, nitrate, metals, other
  - Septic systems --- nitrate, protozoa, bacteria, viruses
- **Other**:
  - Hazardous waste generators --- halogenated solvents
  - Pipelines and sewer lines --- nitrate, protozoa, bacteria, viruses
  - Salt water intrusion --- salinity/brine
  - Urban runoff --- inorganic & organic pesticides, halogenated solvents, petroleum compounds, nitrate

3.0 Comprehensive Monitoring Strategy for All Waters

Guam EPA Monitoring Goals and Objectives are to:

- Conduct a comprehensive assessment of water quality throughout the island using a rotating basin approach;
- Complete a thorough evaluation of monitoring data;
- Evaluate if the quality of island waters are suitable for their designated uses;
- Evaluate if the Guam Water Quality Standards are appropriate and relevant to present conditions in the waters of the island; and

- Coordinate new approaches to improving and protecting the island's water resources through the implementation and enforcement of CWA 319 and CZARA 6217 programs.

To meet all federal and local reporting requirements the CMS for the island of Guam includes ten distinct individual monitoring plans. The programs developed or proposed for each of these plans are:

1. Status and Trends Monitoring Program
2. Guam Environmental Monitoring and Assessment Program
3. Recreational Beach Monitoring Program
4. Wetlands Monitoring Program
5. Fish and Shellfish Consumption Monitoring Program
6. Groundwater Assessment Monitoring Plan
7. Marine Preserve Water Quality Assessment Program
8. Nonpoint Source Pollution Monitoring Program
9. Underground Injection Control Monitoring Program
10. Man-Made Impoundments Monitoring Program

A copy of Guam's CMS is attached as **Appendix E.**

4.0 Programs to Correct Impairments

Guam EPA has programs in place to correct, prevent or minimize the impairment of waterbodies, fresh or marine. These programs are mandated by local and federal statutes, and are implemented to the maximum extent possible. Programs applied by Guam EPA include but are not limited to:

Guam Water Quality Standards
Guam Comprehensive Monitoring Strategy
Section 401 Water Quality Certification
NPDES Permitting
Individual Wastewater System Permitting
Sewer Connection Permitting
Soil Erosion and Sediment Control Regulations
Clearing, Grading, and Stockpiling Permitting
Environmental Protection Plan Requirement
Water Quality Monitoring Requirement
Erosion Control Plan Requirement
Section 319 NPS Programs
Section 6217 Coastal NPS Pollution Program
Feedlot Waste Management Program

Land Use and Wetland Use Permitting under the Guam Land Use Commission
Seashore Protection Permitting under the Guam Seashore Protection Commission
Wellhead Protection Program
Well Licensing Program
Groundwater Programs or Activities listed in Table B10., Appendix B.

Guam EPA also recognizes the Guam Waterworks Authority (GWA) Stipulated Order for Preliminary Relief which outlines a list of mandated actions for GWA. The list includes the development and implementation of a comprehensive Water Master Plan and the financing of water and wastewater capital improvement projects. Continued compliance with this Order should improve water quality as a result of infrastructural improvements to sewage treatment plants, pump stations, and ground water facilities. The completion of the Water Master Plan will also provide a strategic roadmap for the utility to meet quality water demand and the wastewater treatment needs of the island.

5.0 Trends

The quality of Guam's waters will vary considerably, depending on a variety of factors including geology, human population density, level of coastal and urban development, level and types of uses of marine, surface and groundwater resources, to include frequency of natural disturbances, such as typhoons and earthquakes.

The island's economy depends largely on U.S. military spending and tourism. Total U.S. grants, wage payments, and procurement outlays amounted to $1.3 billion in 2004. Over the past 30 years, the tourist industry has grown to become the largest income source following national defense. More than 1 million tourists visit Guam each year including about 930,000 from Japan, 120,000 from Korea, and 22,000 from Taiwan[6]. The Guam Visitors Bureau reported that Guam's arrivals in 2007 inched by (+1.1) 2006's 1,211,674 to 1,225,323 visitors. The growth is a surprise following months of lackluster arrivals from powerhouse Japan. Arrivals from the "*Land of the Rising Sun*" made up 78.9% of Guam's tourism arrivals in 2007. Guam's 2007 tally ranked sixth compared to 1997's banner arrivals of 1,381,513. Taiwan led Guam's visitor markets with the largest year-over-year growth (+30.4%) after a disappointing performance in 2006 (-28.5%). Sharp gains (+60.4%) were posted from Guam's sea arrivals in 2007.

The inflation rate in 2005 was 12.09% compared to 8.95% in 2006. No rate was available for 2007.[7]

Although the agency faces some significant issues of concern (i.e. the Ordot dump closure and the construction of a new landfill, "groundwater under the influence" concerns, impacts of the upcoming military buildup, staff shortages, and funding needs, to name a few), conditions of its EPA Consolidated Grant must be met and objectives of

[6] Information obtained from GVB Visitor Statistics Report, December 2007, Research Archives

[7] Bureau of Statistics and Plans, Guam Consumer Price Index, 4th Quarter 2007, Volume XXIII, No. 4

respective program work plans must be carried out in a timely and effective manner. Guam EPA anticipates significant improvements to both the water and wastewater systems, and other infrastructure, despite the struggling economic situation on Guam.

Activities and programs which support the protection and improvement of water quality on Guam include:

- The continuing development of the island's CMS programs and the implementation of Coastal Monitoring, Wadeable Streams Assessment, Recreational Beach Monitoring, and cooperative efforts with DAWR to complete the Marine Preserve Monitoring Plan;
- Facilitating the provisions of Executive Order 2004-04 relevant to implementing a comprehensive Watershed Planning Process for the Northern, Ugum and Talofofo Watersheds;
- Overseeing and enforcing (with EPA support) GWA compliance of requirements under the Stipulated Order for Preliminary Relief. Drinking water produced by GWA continues to meet Safe Drinking Water Act requirements;
- Ensuring a sustained Safe Drinking Water Program so that potable water produced by GWA and other purveyors continues to meet Safe Drinking Water Act requirements;
- Providing training opportunities for Agency employees and other partner agency personnel, i.e. facilitating technical assistance to improve Guam's Certification Program for Water and Wastewater Systems operators;
- Providing oversight for current and future Title II EPA funded Sewer Construction Grants projects;
- Meeting reporting conditions/requirements, i.e. Guam's CWA 303(d) list of impaired waterbodies; developing and implementing TMDLs for impaired water bodies;
- Funding needed water studies/research projects. Resulting data/information is important in validating the development or modification of strategic source water protection programs and programs targeted to ensure the sustainability of the NGL;
- Maintaining other enforcement and compliance programs. In 2006, about 125 buildings connected to the public sewer system as a result of sanitary surveys and enforcement action. In 2007 staff concentrated on identifying strategic northern locations with available sewer systems and subsequently conducting sanitary surveys of those residences with or without connections to the nearby systems. Enforcement action is forthcoming;
- Developing and/or updating environmental policy, plans, rules/regulations primarily to support compliance and enforcement. As an example, the CNMI/Guam Storm Water Management Manual, Volume I & Volume II, was finalized in October 2006. In partnership with the government's Bureau of Planning and NOAA, Guam EPA is reviewing an initial draft revision to the Guam Soil Erosion and Sediment Control Regulations that incorporates

stormwater management rules based on the Manual. The regulations are expected to be processed via the local Administrative Adjudication Law in 2009;

- Maintaining regulatory oversight of environmental restoration efforts undertaken by the Department of Defense (Navy and Air Force) on Guam to ensure compliance with local and federal laws and regulations. A description of the various DoD contamination issues and completed or on-going projects, are included in this integrated report;
- Conducting the triennial review of the GWQS as required; and
- Implementing information and outreach programs that cause community action to protect and sustain clean air, water and land for Guam.

I. INTRODUCTION

The purpose of the Integrated Water Quality Monitoring and Assessment Report

The Clean Water Act (CWA) requires states to provide every two years an assessment of the quality of all their waters (section 305(b)) and a list of those that are impaired or threatened (section 303(d)). The U.S. Environmental Protection Agency (EPA) subsequently condenses all information from state reports into one summary document which it sends to Congress.

Guam submitted its first Integrated Report (IR) in 2006, which was developed in accordance with *2006 Integrated Water Quality Monitoring and Assessment Report Guidelines (USEPA, July 2005).* All future reports shall be developed in accordance with updated EPA guidelines or directives.

A summary of CWA reporting requirements for sections 303(d), 305(b), and 314, is provided below:

Section 303(d) – a list of impaired and threatened waters still requiring Total Maximum Daily Loads (TMDLs); identification of the impairing pollutant(s); and priority ranking of these waters, including waters targeted for TMDL development within the next two years.

Section 305(b) – a description of the water quality of all waters of the state (including, rivers/stream, lakes, estuaries/oceans and wetlands). States may also include in their section 305(b) submittal a description of the nature and extent of ground water pollution and recommendations of state plans or programs needed to maintain or improve groundwater quality.

Section 314 – in each section 305(b) submittal, an assessment of status and trends of significant publicly owned lakes including extent of point source and nonpoint source impacts due to toxics, conventional pollutants, and acidification.

In satisfying the above reporting requirements, Guam EPA also satisfies the 305(b) reporting requirement for section 106 grant funds. Guam has the means to monitor water quality and annually update water quality data which is included in this submittal.

This IR will:

- report on the water quality standards attainment status of all waters
- document the availability of data and information for each water
- identify certain trends in water quality conditions, and
- provide information to managers and others in setting priorities for future actions to protect and restore the health of our island's water resources

II. BACKGROUND INFORMATION

This section discusses Guam's total waters, the Water Pollution Control Program, actions needed to achieve objectives of the CWA, and special concerns and recommendations.

A. Overview of Guam's Water Resources

The categories of water established under the Guam Water Quality Standards (§5102, 2001 Revision) are Groundwater, Marine waters, and Surface waters. **See FIGURE 2.** **Table 1** summarizes Guam's coastal and aquatic resources.

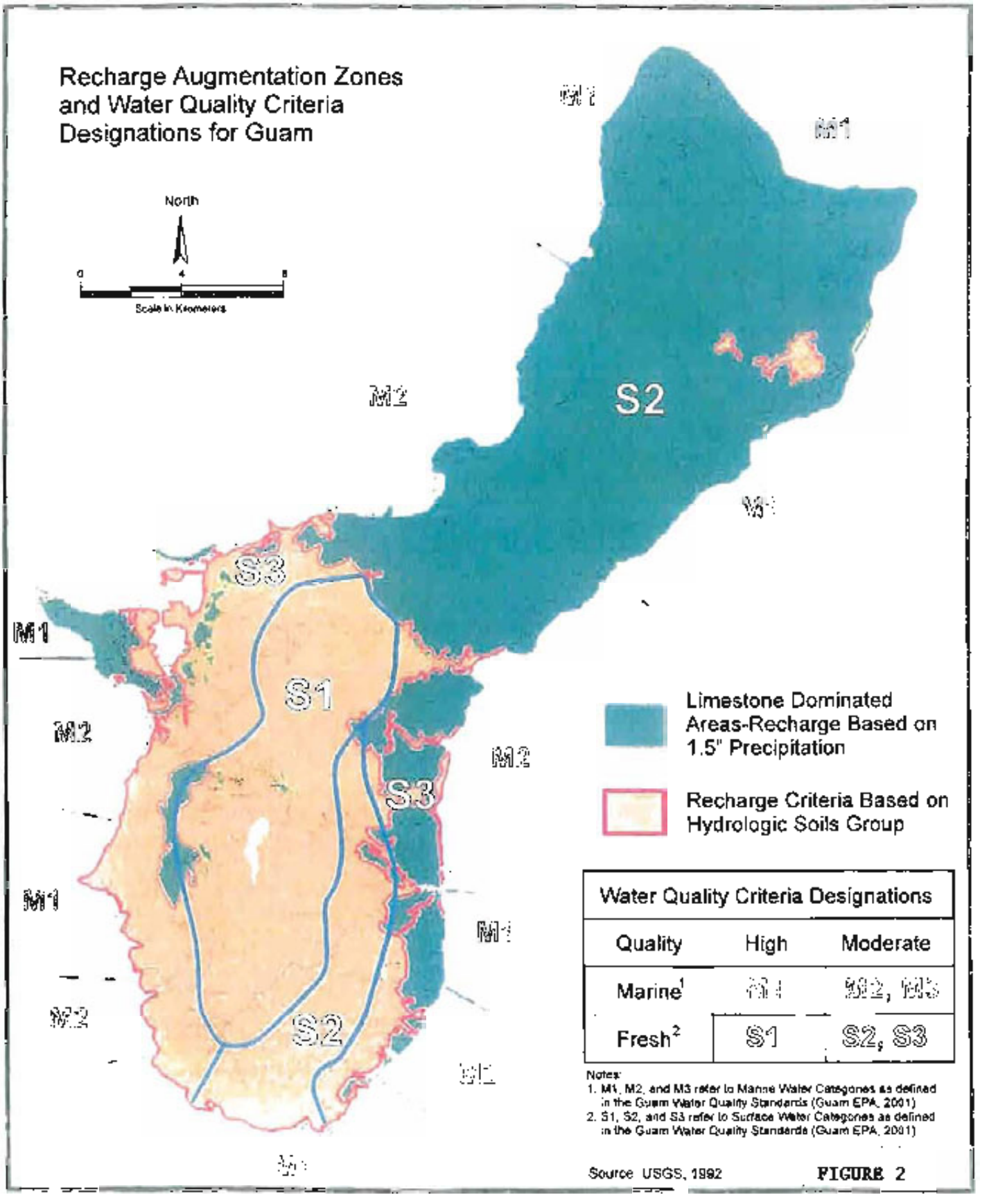
Table 1.
Atlas of Guam Coastal and Aquatic Resources

Topic	Value
State population	**173,456**
Land Surface Area	**212 square miles**
Coast	**116.5 miles**
Sandy Beaches	**35.9 miles**
Coral Reef	**9,080 acres**
Seagrass Beds	**353 acres**
Watersheds (#)	**20**
Perennial Streams (#)	**97**
Streams	**228.65 miles**
Lakes (Reservoir) (#)	**1**
Lakes (Reservoir)	**195 acres**
Freshwater Wetlands	**3,785 acres**
Lacustrine Wetlands	**198 acres**
Estuarine Systems	**915 acres**
Mangroves	**176 acres**

1.0 Groundwater

This category encompasses all subsurface water and includes basal and parabasal water, perched water, all water below the groundwater table, water percolating through the unsaturated zone (vadose water), all saline waters below and along the perimeter of the basal fresh water body (freshwater lens), and water on the surface that has been collected with the specific intent of recharging or disposing of that water to the subsurface by means of injection, infiltration, percolation, etc. The Northern Guam Water lens, which is the Principal Source Aquifer, and any other groundwater resources, as they are identified, shall continue to receive protection under the Guam Wellhead Protection Program and other applicable groundwater regulations (GWQS).

The northern half of Guam, considered the Northern Watershed, has no perennial streams because of the porosity and permeability of its calcareous rock formations. Rainfall percolates rapidly through the limestone to the freshwater lens or aquifer which is in contact with seawater below. This fresh groundwater provides approximately 75% of the



Water Quality Criteria Designations		
Quality	High	Moderate
Marine[1]	M1	M2, M3
Fresh[2]	S1	S2, S3

Notes:
1. M1, M2, and M3 refer to Marine Water Categories as defined in the Guam Water Quality Standards (Guam EPA, 2001)
2. S1, S2, and S3 refer to Surface Water Categories as defined in the Guam Water Quality Standards (Guam EPA, 2001)

Source USGS, 1992

FIGURE 2

public drinking water supply. The aquifer is estimated to have a total average daily recharge of 111.9 million gallons and a sustainable yield of up to 60 million gallons per day (MGD). It is divided into six sub-basins (Agana, Mangilao, Andersen, Agafa Gumas, Finegayen, Yigo) containing 47 management zones.[1] **See Figure 3a.** Over 100 ponding basins associated with developments in northern Guam, collect stormwater runoff which subsequently percolates into the lens.

2.0 Surface Waters

This category includes all surface freshwater and includes (1) waters that flow continuously over land surfaces in a defined channel or bed, such as streams and rivers; (2) standing water in basins, such as lakes, impoundments, and reservoirs, either natural or man-made; and (3) all waters flowing over the land as runoff confined to channels with intermittent flow (GWQS).

The southern half of Guam contains the island's surface freshwater resources. Its volcanic slopes are deeply channeled by 97 streams (16 are major streams) with a total stream length of 228.65 miles. Western slope streams are short with steep gradients and drainage areas of less than three square miles each. The eastern slopes are steep in their upper reaches with long gently sloping streambeds that terminate in wide flat valleys.

The largest inland body of water on Guam is the Fena Reservoir constructed by the Navy as a drinking water supply. Its watershed is 5.88 square miles in area with 195 acres of water surface when full and 7,182 acre-feet of water storage (1949 original design: 8,300 acre-feet). It is the main drinking water source for the Navy. Fena Reservoir water is treated to reduce turbidity and chlorinated.

2.1 Wetlands

Wetlands on Guam (see **Wetlands Map, FIGURE 4a.)** have been officially estimated to comprise less than four percent of the total land area, although more recent field based estimates suggest a substantially greater percentage. Wetlands include swamps, marshes, mangroves, springs, and forested river valleys and are seasonally, but more often, permanently inundated with water or have soil that is saturated at the surface. Some wetlands completely dry up for several months each year. For Guam wetlands are identified, for jurisdictional purposes, in accordance with the U.S. Army Corps of Engineers (USACE) 1987 Wetland Delineation Manual. This manual employs the multi-parameter approach, which requires the combined presence of hydric soils, wetland hydrology and hydrophytic vegetation.

The Guam Land Use Commission/Guam Seashore Protection Commission (Title XVIII and XIV of the Government Code of Guam) expand the federal definition to include ponds, estuaries and surface springs and refer to aquatic life in addition to aquatic vegetation. **Table 2** presents a breakdown of the National Wetlands Inventory of Guam by U.S. Fish and Wildlife Service (FWS) category.

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1 Northern Guam Lens Study , Guam EPA 1982

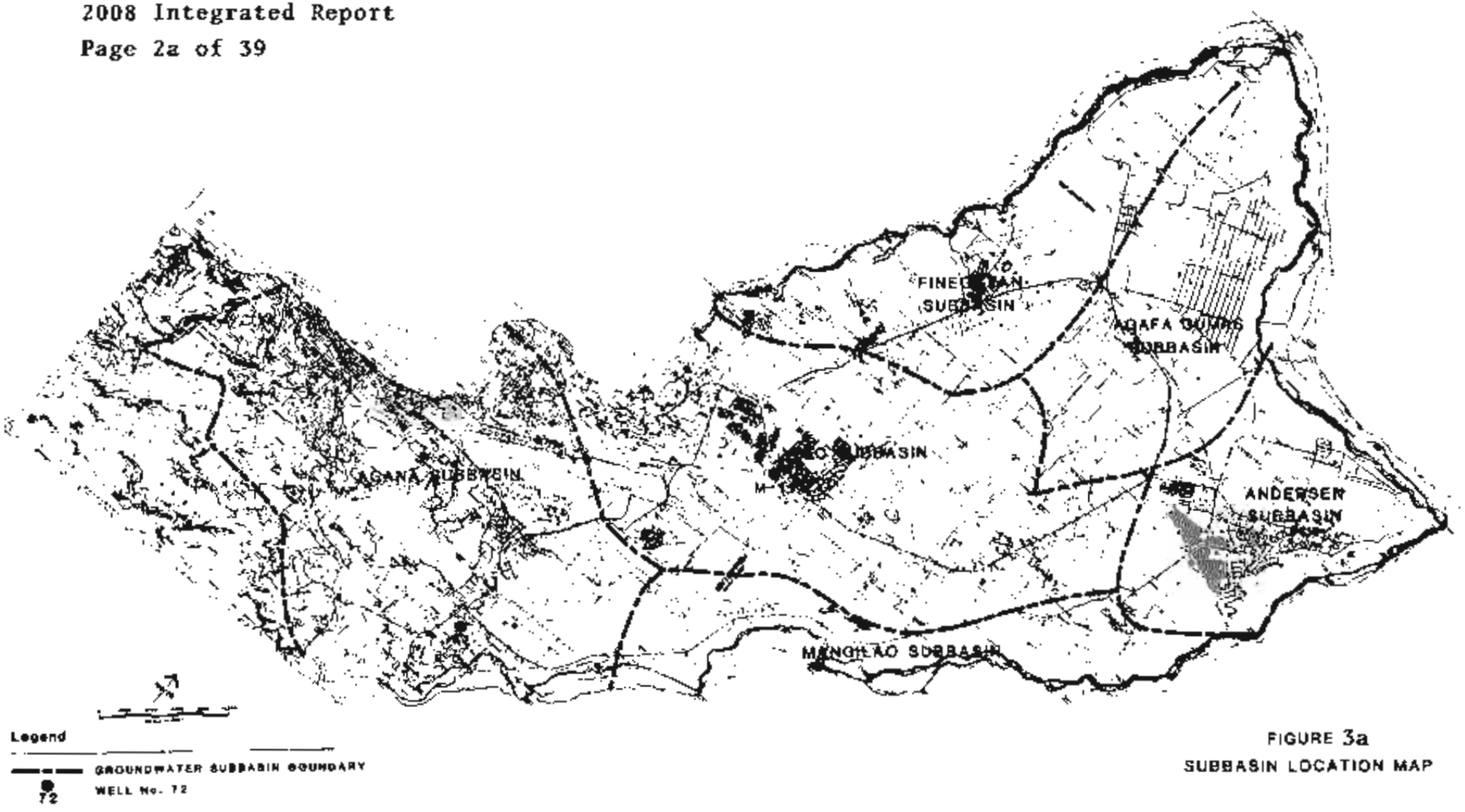

FIGURE 3a
SUBBASIN LOCATION MAP

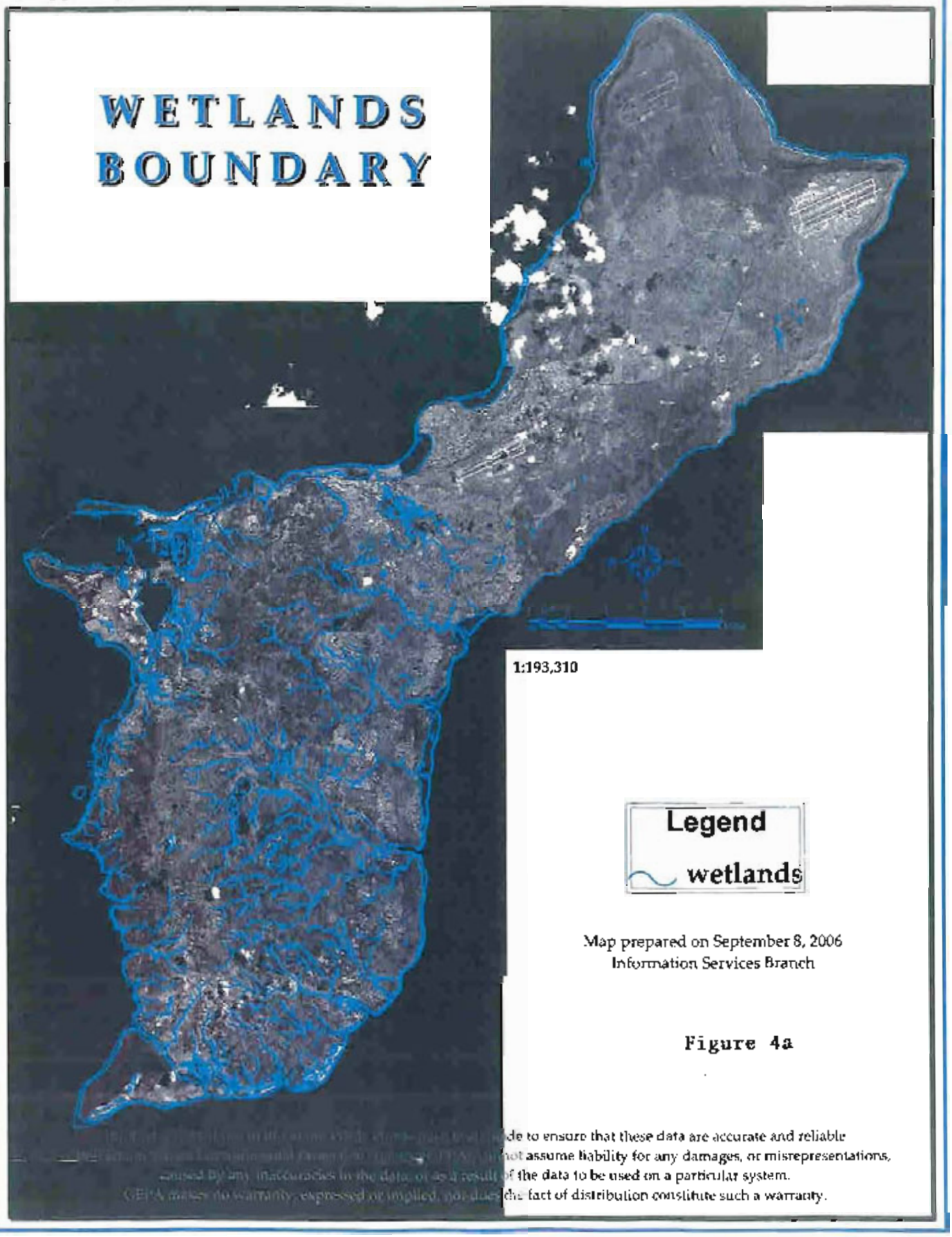

Figure 4a

Table 2. Wetlands Inventory of Guam

FWS Category	Acreage	System
Coral Reef	9,080	Marine
Forested Scrub-shrub	2,170	Palustrine
Emergent Wetlands	1,386	Palustrine
Open Water	713	Estuarine
Seagrass Beds	353	Marine
	198	Lacustrine
Mangrove Forest	176	Estuarine
Unvegetated Shoreline	83	Marine
Open Water/Aq Bed	27	Palustrine
Other	26	Estuarine
	4	Riverine
TOTAL	14,216	

Source. 1983 National Wetlands Inventory

More than 15 years of actual field delineation work has lead both local and federal wetland experts to conclude that the NWI estimates for emergent and forested scrub-shrub wetlands are significantly understated. A significant number of wetland systems have been accurately delineated for Section 404 jurisdictional purposes over the same 15-year period. Maps were digitized and added to the Inventory by the Guam Coastal Management Program (GCMP). Guam EPA maintains copies of jurisdictional wetland delineation maps. Nearly 40 wetland delineation verifications and determinations were made, mostly involving small wetlands systems (less than 1 acre). The majority of these determinations and field verifications were required to facilitate development activities and did not require delineation mapping because plans were made or modified to avoid impacts.

3.0 Marine Waters

This category includes all coastal waters off-shore from the mean high water mark, including estuarine waters, lagoons and bays, brackish areas, wetlands and other special aquatic sites, and other inland waters that are subject to ebb and flow of the tides (GWQS).

The entire island of Guam, classified as a coastal zone under the U.S. Coastal Zone Management Act, is comprised of 212 square miles of land surrounded by 116.5 miles of shoreline. This shoreline is divided into three distinct classifications: rocky coastline, sandy beaches, and mangrove mud flats. The rocky coastline classification outlines the northern end of the island and isolated areas in the south. Rocky coastline represents approximately 72.5 miles in length or 62% of the total shoreline. Sandy beaches are scattered throughout the island and comprise 35.9 miles or 31% of total shoreline. The remaining 8.1 miles or 7% of shoreline are classified as mangrove mud flats and are located primarily within Apra Harbor and in Merizo.

Shallow fringing coral reefs with outer slopes and margins supporting live coral colonies encircle most of Guam. The width of these reefs ranges from very narrow benches (as narrow as 10 to 20 feet) on the northeastern coast, to broad reef flats forming the popular recreational and fishing areas in Tumon, Hagatna, Agat, and Asan Bays and on the shore side of Cocos Lagoon. These reefs are extremely valuable in terms of marine life, aesthetics, food supply, and recreation. Reefs also protect Guam's highly erodible shorelines from storm waves, currents, and tsunamis. Barrier reefs occur at Apra Harbor and Cocos Lagoon. Cocos Island Lagoon and its reefs form an atoll-like environment approximately four square miles in area. Bound by the uplifted limestone plateau of Orote, Cabras Island and a large artificial breakwater (built on a shallow reef platform and adjacent submerged bank) is the much deeper lagoon of Apra Harbor.

The North Equatorial Current, driven by northeast trade winds, generally sets in a western direction around Guam with velocities ranging from 0.5 to 1.0 knots. Guam tides are semi-diurnal with a mean range of 1.6 feet and diurnal range of 2.3 feet. Extreme predicted tide range is approximately 3.5 feet.

Surface sea temperatures average close to 80 degrees Fahrenheit year-round.

B. Water Pollution Control Programs

Protecting and Restoring Guam's Waters[2], September 1999, addresses Guam EPA's overall approach for managing water resources. Guam uses a balanced approach that emphasizes both island-wide nonpoint source programs and on the ground management of individual watersheds where waters are impaired and/or threatened.

The watershed approach is focused over a relatively small land area which is necessary to address problems at a watershed scale. Guam EPA also maintains core programs which are island-wide, covering both point and nonpoint sources of water pollution. These programs are discussed in the following.

1.0 Watershed Approach - Executive Order 2004-04 and the 1998 Clean Water Action Plan for Guam: *Unified Watershed Assessment*

In 1998, President Clinton announced a new clean water initiative to speed the restoration of our nation's waters. This initiative, called the Clean Water Action Plan (CWAP), aimed to achieve clean waters by encouraging federal and non federal agencies, other organizations and interested citizens to work in a collaborative manner to restore our highest priority watersheds.

Guam responded to this federal initiative through Executive Order 99-09, which re-established an interagency work group called the **Water Planning Committee (WPC)**[3]. The 1998 WPC used an NRCS map, which delineated watersheds on Guam, to

2 Document submitted to achieve compliance with update requirements for Section 319 of the federal CWA and related NPS Program and Grants guidance dated May 1996.

3 The Water Planning Committee is now known as Watershed Planning Committee (WPC). It was originally formed in August 1987 under §57034, Title 10, Guam Code Annotated, Public Law 17-87. The WPC became inactive in 1989, was re-established in June 1998 then promulgated through E.O. 99-09. E.O. 2004-04 rescinded the former executive order and restructured the WPC and its

organize the watersheds by category based on national criteria, the data available for each watershed, and the severity of environmental impact suffered by each watershed. That work group decided that addressing the drinking water impairment criterion (by protecting the Island's drinking waters) was a high priority. Drawing on experience and best professional judgment, three watersheds containing key drinking water resources were selected as the WPC's highest priority watersheds; and these three watersheds, Northern, Ugum, and Talofofo, were targeted for initial CWAP restoration during 1999-2000.[4]

1.1 Northern Watershed Restoration Strategy (NWRS)[5]

The NWRS continues to focus on projects to document, investigate, and reduce potential contaminant sources located within the Tumon/Yigo Sub-basin; completing the innovative septic tank design pilot project; and conducting public education and outreach activities designed to help restore the Northern Watershed. Projects on-going during the reporting period include:

a. *Wastewater Revolving Fund Loan Program*: A program developed via a Memorandum of Understanding between Guam EPA and GWA. $75,000 granted to GWA to design and implement a program for eligible applicants to acquire funding (via a low-interest loan) for residential connection to a nearby sewer system. GWA is required to submit quarterly progress reports.

b. *Bacteria TMDL for Impaired Beaches in the Northern Watershed*: Data collected through Guam's Recreational Beach Monitoring Program (RBMP) has served as the basis to place 42 site locations on the Guam §303(d) list. Guam's 2006 Integrated Report indicates that a priority action is to work towards developing TMDLs for impaired Tier I beaches. The purpose of an initial draft document is to help begin that effort by developing a TMDL project plan for twelve beaches located in the Northern Watershed. The TMDL project plan will:

    * Evaluate and recommend the potential for grouping beach TMDLs
    * Identify possible options for completing the TMDLs.

    It starts with a short summary of the setting and general water quality concerns including applicable standards. An important part of the project plan development is to build upon the existing knowledge base. This involves a review and analysis of data collected from project area beaches. Potential sources that affect water quality at the RBMP sites will be summarized and TMDL development options discussed. The ultimate goal of this project plan is to provide EPA Region 9 and Guam EPA with a better understanding of the information needed to proceed with TMDL development, how it should be used, and a list of key issues that the TMDL will ultimately need to address.

1.2 Ugum Watershed Restoration Strategy[6]

The objective of the Ugum restoration strategy is to improve the drinking water quality

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goals. A copy is provided in Appendix D.

4 Clean Water Action Plan for Guam: *Unified Watershed Assessment*. September 15, 1998

5 See Appendix G

6 See Appendix G.

and the ecosystem functioning of the Ugum Watershed. Erosion is the most significant factor interfering with the achievement of this objective. The most effective means of preventing and minimizing soil erosion is to encourage actions which maximize vegetative cover, particularly forest. The following priorities have been identified for an effective Ugum restoration strategy:

a. Conserve and protect the ravine forest.
b. Revegetate badlands within the savanna grasslands.
c. Minimize fires.
d. Inform and involve the public.

A Sediment TMDL for the Ugum Watershed was approved by USEPA in 2006 **(See Appendix F)** and is pending implementation.

1.3 Talofofo Watershed

Guam intends to develop a protection and restoration strategy for this priority watershed in accordance with the approved Guam Coastal Nonpoint Pollution Control Program and other on-going nonpoint source efforts.

The Water and Environmental Research Institute (WERI) is a primary nonpoint source program partner (to Guam EPA and the Bureau of Statistics and Plans) which provides monitoring, technical assistance, training and workshops. During the reporting period a project was funded in part by the National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resources Management and the Guam Coastal Management Program, Bureau of Planning, Government of Guam, through NOAA Grant Award CRI-GU-06; and by the U.S. Department of the Interior, U.S. Geological Survey, through the University of Guam Water and Environmental Research Institute of the Western Pacific. Entitled "*Natural Resources Atlas of Southern Guam*", (www.hydroguam.net) this website is a digital resource center for data related to the physical and environmental characteristics of southern Guam. Its purpose is to provide accurate and easily accessible baseline information to government agencies, environmental specialists, educators, students, and all interested parties. The geographic scope of the atlas is southern Guam, which is defined as the area covered by fourteen southern Guam watersheds; this atlas includes the Ugum and Talofofo watersheds.

The website notes that all surface and groundwater in Guam discharges into the Pacific Ocean. Of Guam's 100 named streams and rivers, 46 drain directly into the ocean. This means that southern Guam has many small drainage basins, which can be grouped into fourteen large watersheds. The main topographic feature that defines many of the watersheds is a mountain ridge running along the western coast. It divides southern Guam watersheds into small and steep areas with short streams in the west, and broader floodplains and longer, larger rivers in the east.

Protecting southern Guam watersheds from point and non-point sources of pollution requires a better understanding of watershed topography, vegetation, soil properties, roads, land cover information, badlands, and many other features. One of the rationales

behind this website is to serve such information to any interested parties including Guam EPA and the Watershed Planning Committee.

2.0 Point Source Pollution Control Program

The Agency implements the following specific programs designed to address known sources of pollution (point sources) including pipes, ditches, and sanitary or storm sewers.

(a) **Permit Compliance** This program activity is implemented through site inspections and surveillance. The Water Pollution Control Program oversees the implementation and compliance of conditions imposed by Guam EPA Water Quality Certification (Section 401) and the National Pollutant Discharge Elimination System (NPDES) permits issued to industrial and non-industrial facilities. (www.guamepa.govguam.net: Guam EPA Environmental Permit Guidebook).

Although the permit system is administered by EPA, Region 9, the Guam EPA Water Pollution Control Program in coordination with the Environmental Planning and Review Division are responsible for certifying all permit applications and recommending the conditions and abatement schedules for each permit. All permittees are monitored by both the Water Pollution Control Program and EPA staff to verify compliance with applicable permit requirements and compliance schedules.

There were nineteen (19) active NPDES permits on Guam in 2007. **See Table 3**. The discharge from these permitted facilities included effluent from wastewater treatment plants, thermal effluent from the power plants and a number of discharges which contained minor amounts of oil and other toxic materials. The guidelines for effluent limitations are based on the Revised 2001 Guam Water Quality Standards.

(b) **Enforcement** - The Water Pollution Control Act and Guam Water Quality Standards authorize Guam EPA to take legal action against those who pollute island waters. Enforcement is carried out through scheduled site and sampling inspections. NPDES permittees submit quarterly Discharge Monitoring Reports (DMRs) to EPA Region 9 for review and evaluation. Appropriate enforcement action is applied for non-compliance to approved permit conditions.

3.0 Nonpoint Source Pollution Control Program

In February 1987 U.S. Congress passed the Water Quality Act which required states and territories to assess nonpoint source problems and develop management programs to control them. Nonpoint source pollution presents a serious threat to the quality of Guam's surface and groundwater. And as the overall designated Agency responsible for protecting the quality of waters in Guam, Guam EPA oversees the following activities under its Water Pollution Control Program, the Watershed Planning Committee and 319 program, and the 6217 program to prevent and control nonpoint source contamination

3.1 Individual Wastewater Permits

Domestic wastewater associated with population increase is the largest potential source of pollution to all waters of Guam. The island's most extensive population development is occurring in the northern watershed above its federally designated sole source aquifer.

Table 3. Federal National Pollutant Discharge Elimination System Permits Guam: 2006 – 2007

Permit No.	Facility	Receiving Water(s)
GU0020087	GWA, Agana STP	Philippine Sea
GU0020141	GWA, Northern District STP	Philippine Sea
GU0020222	GWA, Agat/Santa Rita STP	Philippine Sea
GU0020273	GWA, Umatac-Merizo STP	Philippine Sea
GU0020095	GWA, Baza Gardens STP	Pacific Ocean
GU0020001	GPA, Cabras Power Plant	Apra Harbor
GU0000027	GPA, Tanguisson Power Plant	Philippine Sea
GU0020141	GPA, Piti Power Plant	Philippine Sea
GU0000035	Guam Shipyard	Apra Harbor
GU0110019	USN, Apra Harbor STP	Philippine Sea
GU0020150	Shell Agat Terminal	Apra Harbor
GU0020338	Shell Guam, F-1 Pier	Apra Harbor
GU0020036	Mobil Oil Guam, Inc.	Apra Harbor
GU0020079	South Pacific Petroleum Corp.	Apra Harbor
GU0020281	Continental Micronesia	Harmon Sink
GU0020290	Guam Airport Authority	Harmon Sink
GU0020303	Manenggon Hills Resort	Ylig River
GU0020168	UOG, Marine Laboratory	Pacific Ocean
GU0020346	Unitek Environmental-Guam	Apra Harbor

Source: Guam EPA Water Pollution Control Program

Due to economic difficulties, such development is occurring without adequate sewage infrastructure. As a result, occupants depend on septic tank and leaching field systems for waste disposal.

To control this nonpoint source of pollution, Section 48102, Chapter 48 of 10 Guam Code Annotated (GCA) requires that no building shall be occupied or used as a dwelling, school, public building, commercial building, industrial building or place of assembly without toilet or sewage facilities of a type inspected and approved for the disposition of human excreta and other domestic wastes.

Furthermore, in the northern area of Guam, permitted housing density has been decreased to one residential dwelling unit per half acre of property in unsewered areas to protect the groundwater from contamination.

Permits are required for new and remodeled buildings. To ensure the installation of proper sewage disposal systems, the permitting process includes mandatory on-site inspection and building plan review, permit issuance and final inspection of the completed disposal system. Building occupancy permits are only issued upon approval of the structure's sewage disposal system.

Table 4. Wastewater Permits 2000-2007

Permits Issued	2000	2001	2002	2003	2004	2005	2006	2007	TOTALS BY PERMIT TYPES
Sewer Connections	152	89	88	154	110	143	198	226	1160
Septic Tank/ Leaching Field	398	281	171	311	163	171	203	228	1926
Miscellaneous Permits	115	105	62	99	289	522	556	465	2213
ANNUAL TOTALS	665	475	321	564	562	836	957	919	5299

Source: Guam EPA Water Pollution Control Program

During the reporting period a total of one thousand eight hundred seventy-six (1,876) permits were issued. Of this, four hundred twenty four (424) were sewer connection permits, four hundred thirty one (431) were permits for septic tank/leaching field systems, and one thousand twenty-one (1021) were miscellaneous permits. **See Table 4.**

3.2 Soil Erosion and Sediment Control Program

Soil erosion is one of the island's most serious nonpoint source pollution problems especially in the southern area. With increased local development, in particular the movement of land development to the southern half of the island, disturbance of Guam's soil caused by site grading operations and by burning of natural vegetation has greatly accelerated erosion that follows every rainfall. Erosion not only removes the productive top soil and substrata, it leaves scars which regenerate growth with much difficulty. Eroded top soils are transported to streams and rivers, reefs and beaches, where recreational sites and wildlife habitats are destroyed. The fragile, filter feeding organisms of the reef are smothered, light penetration into the water is drastically reduced and silt covers the bottom with a soft layer unsuitable for bottom-dwelling plants and animals. As pollution increases, the productivity decreases and the fish and other animals die or leave the area.

Guam EPA enforces the *Guam Soil Erosion and Sediment Control Regulations* (P.L. 25-152) to prevent, reduce, and control soil erosion or other environmental impacts to the community. Enforcement action is supported by an active inspection program and a thorough application review and approval process for all clearing, grading, or stockpiling permits. For most clearing and/or grading permits involving disturbed areas

of one acre or more, there must be an accompanying Erosion Control Plan (ECP) which sets specific conditions to protect the quality and designated uses of the waters of Guam.

During 2006-2007, a total of three hundred fifty eight (358) permits were issued and subject to compliance with the Guam Soil Erosion and Sedimentation Control Regulations. Of this total, one-hundred sixty-nine (169) were permits for clearing; one hundred eight (108) were permits for grading; and eighty-two (82) were permits for clearing and grading. **See Table 5.**

Table 5. Clearing & Grading Permits 2000-2007

Activity	2000	2001	2002	2003	2004	2005	2006	2007	Activity Totals
Clearing	55	51	41	37	57	76	90	79	317
Grading	45	57	40	32	22	33	53	54	229
Clearing and Grading	13	27	19	14	23	40	41	41	136
Annual Totals	113	135	100	83	102	149	184	174	682
Erosion Control Plan	42	29	59	19	28	41	69	51	338

Source: Guam EPA Water Pollution control Program

3.3 Feedlot Waste Management Program

In 1986, the Guam EPA developed Feedlot Waste Management Regulations (http://www.guamepa.net/regs/feedlot_regs.pdf) to control livestock operations which generate in excess of one hundred (100) pounds of waste per day. This volume constitutes a significant concentration of waste that would typically be generated by facilities housing approximately 20 swine or 500 fowl. On-site visits to smaller livestock operations are undertaken when identified; and where improper handling of wastes exists, corrective action is recommended to the operator. The problem associated with these smaller facilities is frequently handled through modifications in "housekeeping" procedures. The need to develop specific control over the smaller operations has yet to be evaluated.

Improper handling, treatment and storage of wastes from livestock operations are a concern because of the potential contamination of the island's water resources. In southern Guam, improper control of livestock wastes results in pollutants being transported to surface waters, similarly in the north such wastes are readily transported through the porous limestone to groundwater.

All local proposed feedlot operations are required to obtain a permit from the Department of Public Works. The permitting process involves zoning assessment and site approval by the Department of Land Management and assessment for proper vector control measures by the Department of Public Health and Social Services. Guam EPA reviews the feedlot operations permit application and the facility plans and specifications to assess the adequacy of waste storage, disposal and treatment facilities. Once construction is

completed and Guam EPA has inspected and approved the facility, an operating permit is issued to the proposed feedlot operation. Program staff annually monitor feedlot operations to verify compliance with respective regulations and operation and maintenance standards for the permitted facility.

The Agency also responds to reported complaints possibly connected to illegal livestock operations. A notice of violation may be issued to any person found in violation of the Feedlot Waste Management Regulations.

No commercial feedlot operators were registered with Guam EPA during the reporting period.

3.4 Urban Runoff

Urban runoff is one of Guam's most voluminous nonpoint source problems which impacts both groundwater and coastal waters. Urbanization generally increases the sheer volume of stormwater runoff because of the large amount of impermeable surfaces associated with construction or land development. As a result, rainwater is not naturally allowed to percolate into the ground.

Guam EPA has made great improvements through the implementation of permitting requirements under its Nonpoint Source Management Program. Large and commercial developments are now required to submit "Best Management Practices" for the total elimination of storm water discharges to near shore waters of Guam. In Tumon Bay, discharges have been decreased with the elimination of most existing storm drains near shore.

During the reporting period (October 2006) the *Guam/CNMI Stormwater Manual* (the Manual) was finalized. Executive Order 2005-35 promulgated on October 21, 2005, provided for the interim adoption of the Guam stormwater management criteria for the Department of Public Works and other government of Guam projects. The Agency is in the process of developing local stormwater regulations based on criteria in the Manual and intends to incorporate them into a revision/update of current soil erosion and sediment control regulations. Upon approval and adoption, such regulations will be applicable to and enforceable upon both public and private sector communities.

3.5 Federal Sewer Construction Grants

The Water Quality Act of 1987, which amended the Federal Clean Water Act, provides for the establishment of the State Revolving Fund Program which may be used for the construction of publicly owned sewage treatment works and related facilities in rural communities.

Under Section 201 and 601 of the Federal Clean Water Act as amended, Guam EPA administers the use of federal funds to control point and nonpoint source pollution, resulting from small communities that generate raw sewage discharges and/or have on-site disposal systems, which do not function properly due to poor soil characteristics and/or improper operation and maintenance. Guam receives its allotment of federal funds

based on its construction needs, in accordance with a construction grants priority list and system established by the Guam EPA Board of Directors. The priority list is revised annually to reflect impacts of each individual project on public health and the Northern Aquifer, the island's designated sole source of drinking water. Since 1968, over $59 million has been provided to Guam by the EPA for the planning, design, and construction of wastewater collector systems and treatment facilities, as mandated by Title II and VI of the Federal Clean Water Act as amended. During the reporting period, the pre-final inspections were conducted and close-out activities for the Leyang South Barrigada Collector System, Phase I and the Chaot/Marine Drive Relief Sewer System projects were completed; and the design of the Agat Collector System, Phase IV is completed, but construction is on-going.

4.0 Guam Water Quality Standards (GWQS)

Guam's Water Quality Standards are provisions of law which establish both the water quality goals for specific waters, and the regulatory basis for treatment controls and strategies. GWQS were initially adopted in 1975, and revised in 1987 and 1992. These standards were most recently revised in 2001 and received EPA Region 9 approval in 2002. The most notable revisions address 1) *Anti-degradation*. The existing policy was revised to meet federal requirements 2) *Groundwater*. Numeric water quality criteria for groundwater were included. The criteria help clarify what water quality levels are necessary to retain our sole source aquifer as an acceptable drinking water resource. 3) *Numeric Criteria for surface waters*. Numeric criteria (e.g. microbiology, pH, nutrients, and toxic substances) were updated and newly adopted to reflect updated federal requirements. 4) *Effluent limitations*. Protections were included for threatened and endangered species, and for those organisms harvested for food. Sections were added which allow schedules of compliance for point source discharges that need time to comply with the new requirements, establish federally required low-flow requirements for permit limit calculations, and identify petroleum spill prevention requirements for those facilities having a capacity of 660 gallons or greater. 5) *Wetlands and water quality certifications*. Requirements related to these sections were clarified. Unnecessary or redundant language was removed. Application forms were eliminated from the body of these standards so that revisions to the forms can be made by Agency staff as necessary, without going through a regulatory revision process.

[Guam's Water Quality Standards (122 page document) can be reviewed electronically at http://www.epa.gov/waterscience/standards/wqslibrary/territories/guam_9_wqs.pdf]

Guam EPA is assessing the need for further revision to the GWQS and intends to submit its findings to EPA in the next reporting period. Priority issues under consideration include:

- development of biological indices for water quality in all waters
- development of local wetland water quality standards
- re-assessment of marine water classifications: M-1, M-2, M-3
- new parameters for sediment quality criteria for selected contaminants
- changes to or clarification of mixing zone standards

5.0 Total Maximum Daily Loads (TMDLs)

A TMDL specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and allocates pollutant loading among point and nonpoint pollutant sources. A TMDL also includes a margin of safety to ensure protection of the water.

EPA has approved one TMDL for Guam: *Sediment TMDL Ugum Watershed* prepared by Tetra Tech, Inc. and EPA for Guam EPA in October 2006. **(See Appendix F.)** Priority action is also indicated in this IR to work towards developing TMDLs for impaired Tier 1 beaches. An initial draft project plan has been prepared by Tetra Tech, Inc. to evaluate and recommend the potential for grouping beach TMDLs; and identify possible options for completing the TMDLs.

5.1 The Clean Water Act and the 303(d) List

Under section 303(d) of the 1972 Clean Water Act, Guam is required to develop its list of impaired waters. These impaired waters do not meet water quality standards that Guam has set, even after point sources of pollution have installed the minimum required levels of pollution control technology. The law requires that Guam establish priority ranking for waters on the list and develop TMDLs for these waters.

Section 303(d) of the CWA requires each state to submit an updated 303(d) list of impaired waters to EPA every two years. The 303(d) list provides a way for Guam EPA to identify and prioritize water quality problems. The list also serves as a guide for developing and implementing watershed recovery plans, to protect beneficial uses while achieving federal and state water quality standards. The list is meant only as a means of identifying water quality problems-not the cause of water quality problems.

Causes of water quality problems are determined when water quality management plans are developed for the watersheds in which the listed segments are located. These plans contain controls referred to as the TDML.

5.2 Guam EPA's Methodology for Developing the 303(d) List

Guam EPA compiles the 303 (d) list using existing scientific data and best professional judgment to assess water quality and to determine which waterbodies should be listed. Guam EPA develops a draft list and presents the list for public comment. All public comments are reviewed and evaluated in the development of the final 303(d) list that is forwarded to the EPA for approval.

Guam EPA seeks all available information to determine if Guam's surface water is violating water quality standards. The 303 (d) lists include data submitted by individuals, organizations and government agencies, as well as Guam EPA monitoring data. The Agency actively contacts agencies that collect data as part of their land and resource management activities.

Guam EPA follows federal criteria, GWQS, and scientific protocols in developing the list. It reviews all data submitted to make sure the submissions meet specified minimum quality assurance requirements:

- Sampling and analysis must be conducted under a written Quality Assurance/Quality Control Plan or by established and approved protocols
- Data must demonstrate that field instruments were operated according to accepted methods
- Data must demonstrate that biological monitoring followed standardize protocols
- Data must demonstrate that certain other testing methods complied with accepted practices

EPA listing guidelines require that Guam demonstrate good cause for not placing a waterbody on the list. If available data indicates a waterbody is not meeting water quality standards, and the data meets listing guidelines, then Guam EPA must assume that the waterbody is water quality limited.

Guam EPA does not have information on all Guam waterbodies. Those without information, or information not compatible with the EPA guidelines, are not included on the 303(d) list. Streams and rivers with suspected problems are identified as "Waterbodies of Potential Concern." Streams and rivers will not be placed on the 303(d) list until sufficient data is available that indicates a violation of water quality standards.

Guam EPA is mandated to protect water quality by establishing standards (GWQS) to protect beneficial uses. While there may be competing beneficial uses in a waterbody, federal law requires Guam EPA to protect the most sensitive of these beneficial uses. Guam EPA standards include parameters such as bacteria, pH (acidity level), turbidity, and dissolved gas, certain toxic and carcinogenic compounds, habitat and flow modification, and aquatic weeds or algae that affect aquatic life.

5.3 Listed Waterbodies

Once a waterbody is placed on the 303(d) list Guam EPA must develop a TMDL for that waterbody. Guam EPA has committed to develop TMDLs on listed waterbodies within 10 years. This time frame takes into account the urgency to protect public health, safeguard Guam drinking water sources, and the desire of landowners to begin working on restoration efforts.

Guam EPA's comprehensive watershed approach for protecting water quality includes developing TMDLs for both point and non-point sources. When establishing limits for pipes (point sources), Guam EPA monitors to determine what pollutant is causing water quality problems and in what amounts it is entering the water. The monitoring also attempts to determine how much of the pollution comes from non-point pollution, such as surface runoff, and how much is naturally occurring.

Guam EPA also uses computer models to determine what effect point source pollution is having on the waterbody, and how much of the pollutant can be discharged without exceeding water quality standards in the watershed. Computer modeling is also used to establish permit limits on the amount of pollutant each pipe can discharge.

When controlling pollution from non-point sources, several factors must combine to form a comprehensive approach to TMDL development.

5.4 Water Quality Management Plan Development

The Clean Water Act requires the state to develop a water quality management plan or TMDL to reduce pollution on each waterbody on the 303(d) list. Water quality management plans to restore waterbodies to water quality standards, will be developed by government agencies in cooperation with landowners. If the land is agricultural, then the Guam Department of Agriculture and the Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture may be involved to work with the landowners in the watershed to devise and implement a management plan. Federal agencies (such as the U.S. Navy and the Air Force) would have responsibility to develop water quality management plans of federal lands, with oversight by Guam EPA. The above plans should be sent to Guam EPA for inclusion in an overall watershed plan, which Guam EPA would then submit to EPA for approval.

5.5 Removing Waterbodies from the 303(d) list

Those watersheds that have management plans approved by EPA will have their waterbodies or waterbody segments removed from the 303(d) list. A waterbody is removed from the list when there is evidence that:

- A TMDL has been approved;
- Water quality standards are met;
- Water quality standards are violated due only to natural conditions (meaning that there is no human-caused influence);
- The original listing was in error.

Guam EPA will continue to evaluate waterbodies taken off the list to ensure that management plans are being implemented, and water quality standards achieved.

Guam's 303(d) list is presented in **Table 23.**

6.0 Program Coordination With Other Agencies

One of the elements of Guam's strategy for effective water quality protection and restoration and pollution prevention is "*utilizing and developing our local expertise*"[7]. Guam EPA recognizes the importance of engaging and coordinating with others on this island, in an effort to better protect and manage Guam's water resources. The information and collaborative partnerships established by working with others will help the island identify its resource problems and priorities, and collectively develop and implement effective resource protection and restoration activities.

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7 *Protecting and Restoring Guam's Waters, (Guam EPA September 1999)*

Key components of Guam's approach include:

- Interacting with other agencies and organizations and capitalizing on the best resources possible;
- Establishing executive and legislative support to sustain the long term commitment necessary for environmental work;
- Working closely with the military, a major island landowner, particularly regarding land use activities and impacts resulting from significant increases in military presence;
- Capacity building facilitated through technical assistance, workshops, and training activities; and,
- Promoting public involvement and environmental education.

6.1 Interacting With Other Agencies and Organizations

6.1.1 *Taking the lead on maintaining the Watershed Planning Committee (WPC)*[8]

The committee meetings, and all documents prepared by the WPC, are open to the public. The WPC is currently made up of representatives from the following organizations and agencies:

(Mandatory)

Bureau of Statistics and Plans
Department of Agriculture
Department of Land Management
University of Guam Marine Lab
Department of Parks and Recreation
Port Authority of Guam
Department of Education
Department of Public Works
Guam Waterworks Authority
University of Guam Water and Environmental Research Institute
University of Guam College of Natural and Applied Sciences
Guam Environmental Protection Agency (Chair)

(Membership by Invitation)

U.S. Navy, U.S. Air Force, U.S. Coast Guard, U.S. Department of Agriculture, Natural Resources Conservation Service, U.S. Environmental Protection Agency, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Park Service, U.S. Fish & Wildlife Service, Northern and Southern Guam Soil and Water Conservation Districts

Projects accomplished with a high level of WPC involvement illustrating the types of projects of interest to the WPC, include:

- Publication of Guam's Unified Watershed Assessment, which included the delineation, categorization and prioritization of watersheds on Guam;
- Development of restoration strategies for the two highest priority watersheds identified in the Unified Watershed Assessment;

8 Executive Order 2004-04, Appendix D

- Initiation of implementation of restoration strategies in Guam's priority watersheds;
- Development of an interagency monitoring strategy for the Ugum Watershed restoration project, and the beginnings of discussions between agencies about collaborative water quality and bio-monitoring work;
- Completion of a Watershed Executive Order to promote the watershed approach; and
- Review and comment on documents and work products relative to strategies for managing water resources on Guam.

6.1.2 *Participating in External Forums to Improve Water Resources Coordination*

One of Guam EPA's priorities is to improve coordination between the highly overlapping areas of freshwater and coral reef protection activities, coastal zone and watershed programs, and water quality regulatory actions. This requires working with partner agencies (e.g.; GWA, Division of Aquatic Wildlife Resources, Division of Forestry, University of Guam Marine Lab, WERI, and Bureau of Planning's CZMP). Interactions are increasing and improving, simply as a direct result of collaborative work. This provides frequent opportunities for sharing expertise, ideas and perspectives, and laying the groundwork for positive long term collaboration.
Specific examples of collaborative work include:

- Weekly meetings between Guam EPA and GWA to discuss drinking water and wastewater management efforts;
- Participating in WERI's environment advisory board. This will expand involvement, as resources allow, in Natural Resource Conservation Service councils, environmental organizations and environmental arms of the hotel and tourist associations;
- Actively participating in the Coastal Reef Initiative, to identify and implement projects to protect the health of coral reef ecosystems.
- With regard to the anticipated military build-up, participating in the Civilian Military Task Force meetings and meetings of its environmental and natural resources sub-committees;
- Working with other GovGuam and non governmental organizations to promote and carry out environmental priorities.

6.2 Establishing Executive and/or Legislative Support

All inter-organizational projects need external acknowledgment and support to be effective on a long-term basis. Executive and legislative support is particularly valuable. Guam EPA developed a Watershed Executive Order which was signed by the Governor in August 1999. This order was rescinded in 2004 by a new Executive Order 2004-04, which restructured the Watershed Planning Committee and its goals. The Watershed Planning Committee will work to keep the legislative and executive branches informed of their activities and plans. The WPC intends to establish a working relationship with both the legislative and executive branches to facilitate the development of legislation in support of WPC goals and projects and the watershed approach.

6.3 Working Closely With the Military

Under the Defense Environmental Restoration Program, the Department of Defense has been conducting environmental restoration activities at its Navy and Air Force facilities on Guam. These activities focus on reducing the impact of present and past contamination from military operations. Additionally, the Navy, through the Base Realignment and Closure Program (BRAC), has been actively investigating and mitigating the impact of past contamination looking toward the return of U.S. Government lands to the people of Guam. The BRAC process involves Guam EPA and numerous other agencies and members of the public. Meetings are currently held twice a year, during which technical updates, work progress and relevant issues and concerns can be addressed. Environmental concerns and requirements for military work to proceed in accordance with local laws and regulations are frequent topics.

Air Force facilities on Guam (i.e. Andersen Air Force Base) are on the Superfund list of sites requiring cleanup under federal CERCLA regulations. Guam EPA was an equal player in the negotiation and implementation of the Federal Facilities Compliance Agreement (FFCA). The FFCA set out enforceable schedules and actions that the Air Force must undertake on Guam with oversight by both EPA and Guam EPA.

Guam and EPA environmental regulations and statutes govern Navy clean up operations on island. The funding that the Navy receives for cleanup activities is incumbent upon continued compliance with local laws. Guam EPA provides the necessary oversight to ensure compliance. Additionally, any lands that the Navy plans to return to the people of Guam must go through a rigorous environmental baseline survey to ensure that the property being transferred is not contaminated. If contamination is found, appropriate cleanup work is scheduled and implemented under Guam EPA oversight. Guam EPA has overseen the design, and installation and operation of two groundwater remediation systems at military facilities to date. The Navy has installed an Activated Carbon filtration system to help remediate a TCE plume identified beneath the former Naval Air Station in Agana. Similarly, the Air Force installed an air stripper used to remediate groundwater contaminated with TCE, PCE and TCA. Both remediation systems are used to restore contaminated groundwater to within Safe Drinking Water standards, which is subsequently used as a drinking water supply.

During the reporting period, Guam EPA and representatives of the military (Navy and Air Force) saw a need to form a "Permit Subcommittee". Identified goals include:

- Streamline the permitting process. Provide a high quality permit application so that Guam EPA review can be based on all the information needed.

- Know what the ideal permit application looks like. This will save time in preparation and time in review.

- Clearly understand the legal justifications for the permits by identifying the statutes, regulations, policy and guidance from which the permits are

required. If it is a legal requirement, the military can request funding to prepare the applications.

- Clearly understand what Guam EPA uses to judge the adequacy of the engineering designs in the permit applications.

- Get to know each other and our organizations better and build a good working relationship.

- Educate and share technical and process knowledge for the work done. This could lead to more environmental friendly construction projects.

- Quantify the workload in terms that all can understand and use it to project the resources needed for the military buildup.

- Have a tangible work product no later than August 2008. The work product should be guidance (perhaps web-based) for all other regulated parties seeking permits with Guam EPA. Use the Guidebook to Development Requirements on Guam published by the Bureau of Statistics and Plans as a model.

- Meet once a month (every 4th Thursday) or more often if necessary.

6.4 Capacity building through technical assistance, workshops and training

Given Guam's small local population, limited expertise, and geographical isolation, capacity building (building our expertise) is critical. Guam's approach to improving its expertise is evolving. Various forums for capacity building, including the WPC, on-the-ground assistance, training, and workshops are utilized.

On-the-ground technical assistance is an important component of capacity building. It is one of the areas that occupy the majority of Agency time. Guam EPA assistance is intended to promote water management objectives consistent with both coastal zone and non point source management measures. Examples include inspections of drinking water systems, septic tank/leaching field systems, and erosion and sediment control projects. All involve extensive interaction with and training and education of "customers" as to the environmental or public health aspects of the particular situation, and the regulatory/programmatic considerations.

The Agency also provides technical assistance to architects, engineers, the public and Government of Guam agencies during the design stage and plan review process of projects. During these phases, Guam EPA recommends and/or requires the best management practices and management measures suitable for the sites under evaluation. Non-regulatory groups, such as Bureau of Planning, NRCS, Conservation Districts, Extension Services, Division of Aquatic Wildlife Resources (DAWR), Division of

Forestry, and WERI, are also engaged in capacity building, by promoting activities consistent with CZM and 319 objectives in their work. Examples of a few of their relevant activities include:

- Environmental Quality Incentive Program (NRCS)
- Hosting Pacific Basin Association of Conservation Districts workshops
- Forest Stewardship programs (Division of Forestry)
- Publications of "Man, Land and Sea" (Bureau of Planning environmental newsletter)
- Education on appropriate use of fertilizers and pesticides through meetings with landscapers, 4-H programs, newspaper articles, and other forums (UOG - CALS)
- Educational presentations focusing on watersheds and marine conservation (DAWR, Guam EPA, WERI, and many others)

Workshops are also vitally important to local staff. They provide an option for training and for sharing expertise and ideas. With the shrinking economy, Guam EPA has increasingly looked to on-island workshops and on-line webcasts to fulfill this need. During 2006-2007, with the assistance of EPA Region 9, Guam EPA sponsored the following workshops:

- GWUDI workshops
- Risk Assessment and Communications
- Pacific Islands Environmental Conference

Guam EPA staff attended workshops and/or training opportunities to include:

- Pacific Island Regional Workshop
- Sanitary Survey Workshop
- US Coast Guard oil spills and incident response training
- Laboratory technique, data system and safety training
- University of Guam Coral Reef Workshops
- Hazardous Materials Workshop
- ARCGIS I Workshop
- Industry Forum (related to the military buildup)
- PEACE TALK – Mediating Environmental Conflicts
- Preventing Deficiencies in Water and Wastewater Systems
- Inspector Training and Certification Workshop
- AWWA Expo and Conference

6.5 Public Involvement and Environmental Education

The government of Guam is collectively responsible for the current and future state of water resources on Guam. Perhaps the most significant long term impact the government can make in protecting and restoring these resources is to involve the public in this objective, and to support environmental education. Guam EPA is actively involved in this area in the following ways:

- Seeks review and comment in the development of all plans and regulations from the Guam EPA Board of Directors and from the public at large;
- Supports the WPC;
- Leads annual Earth Week activities. Typical Guam EPA Earth Week activities include public tours of its facility for Guam's school children, mall displays, contests, educational newspaper, magazine, television and radio inserts, and highly popular block parties and island pride festivals;
- Actively participates in numerous Island clean-up activities; and
- Provides environmental presentations to numerous public schools, real estate groups, legislators and mayors, local Chamber of Commerce and other business groups, etc. throughout the year.
- Participates in public forums or public hearings especially as they relate to environmental issues

7.0 Water Pollution Control Programs and Improved Water Quality

Guam EPA's water pollution control programs have made significant progress in maintaining or improving the water quality on island. Program efforts include:

- During the reporting period, Guam EPA provided oversight for the remaining active Title II EPA funded ($4.2M) Sewer Construction Grants project (Sewer Collector System) in Old Agat. The implementation of this project confined disposal of pollutants so they would not migrate to cause water or other environmental pollution.
- With the exception of the GWA sewage treatment plants, all NPDES permitted facility effluent limitations meet Guam Water Quality Standards. The annual permit compliance inspections continue to be conducted for those major facilities; and the minor facility inspections have been likewise conducted every two years. GWA sewage treatment plants improvements are included as conditions of the GWA Stipulated Order for Preliminary Relief. Improvement is needed in the implementation of compliance monitoring inspections of the seventy-two (72) pump stations integral to system of GWA sewage treatment plants.
- During the reporting period, Water Pollution Control Program staff aggressively conducted a sewer survey and assessed existing wastewater disposal systems in northern Guam, documenting those locations such as Bello Road and Agafa Gumas, where public sewer systems were provided and completed. Because enforcement action was initiated, about 120 buildings were connected to the nearest available public sewer system.
- The enforcement and implementation of Guam's Soil Erosion and Sedimentation Control Rules and Regulations was significant during the reporting period. Parties conducting clearing and/or grading activities without a proper permit were subsequently assessed penalties for this violation. Guam EPA registered an estimated thirty percent (30%) increase in the numbers of clearing and/or grading permits since the last reporting period in 2006.
- Over the last four years, the Water Division collaborated with Saipan DEQ to compile a comprehensive guidance manual, to assist the local engineering and development communities and local government agencies in developing and implementing

stormwater and erosion control plans that adequately address nonpoint source pollution through the use of currently accepted best management practices. This CNMI/Guam Draft Storm Water Management Manual, Volume I & Volume II, was finalized in October 2006. The local administrative adjudication process is quite extensive and Guam EPA involved stakeholders in public hearings, issuing public notices about the draft Manual's availability for review and the schedule of meetings to discuss public concerns. The Agency sponsored stormwater management training and invited stakeholders from public and private agencies to attend. Although the Governor via Executive Order has adopted the Manual criteria for public projects, the Agency intends to facilitate the approval of new stormwater regulations based on the Manual, so that stormwater management can be duly regulated for any public or private sector project.

7.1 RECOMMENDATIONS:

7.1.1 *Watershed Planning Committee Support*

Guam EPA should lead and maintain regular meetings of the WPC and facilitate the course of action mandated by Executive Order 2004-04. The initial interagency WPC work group did a phenomenal job in assessing the island's watersheds (1999) and developing an action plan for restoring and protecting them. Since that effort, the effectiveness of the group has been marginal. A program coordinator was hired to oversee the watershed planning initiative in 2007. A newly constituted Watershed Planning Committee was formed and did meet in September of 2007. Quarterly meetings are projected, however additional manpower is necessary to support the critical process of watershed planning and management.

7.1.2. *Nonpoint Source (NPS) Pollution Monitoring*

By the next reporting period, the Water Division should complete its draft strategy for the NPS Pollution Monitoring Plan.. The Comprehensive Monitoring Strategy includes Nonpoint Source Pollution Monitoring" as one of its ten monitoring programs. The goal of such assessment activity is to identify nonpoint source pollutants affecting water quality. In general, NPS Pollution Monitoring will involve:

a). Assessing water quality based on a variety of monitoring data such as

- information from previous 305(b) and related plans
- permitting data
- enforcement records and existing GIS data
- Guam EPA quarterly reports
- water quality reports developed by NPS
- compliance monitoring reports submitted to Guam EPA

b). Performing discrete sampling events for site specific activities, as well as sub-watershed areas encompassing several square miles, to evaluate stormwater runoff contaminants from a variety of land uses;

c). Evaluating nonpoint source Best Management Practices (BMPs) implementation to understand the most effective combination for reducing nonpoint source pollutants.

7.1.3 *CNMI/Guam Storm Water Management Manual*

Guam EPA should complete the comprehensive review and approval process involving this important document and enforceable regulations for soil erosion, sediment control and stormwater management. When this is accomplished, the Manual and its accompanying regulations will be a guide :

a) to protect the waters of the CNMI and Guam from the adverse impacts of urban stormwater runoff
b) to provide design guidance on the most effective best management practices (BMPs) for new development sites and redevelopment sites both during post construction, and
c) to improve the quality of BMPs that are constructed in the CNMI and Guam, specifically in regard to their performance, longevity, safety, ease of maintenance, community acceptance and environmental benefit.

7.1.4 *Environmental Education Committee*

The Agency should continue to support this active inter-agency sub-committee of the WPC which has implemented a diversity of creative and unique projects related to water pollution control. Representative members include: government Guam's Bureau of Statistics and Plans/Coastal Management Program, Department of Agriculture/ Division of Aquatics and Wildlife Resources/Forestry, UOG Extension Service: and (federal agencies) WESPAC, NOAA, Army National Guard, National Park Service; lastly, a local high school Environmental Club – Marine Mania. The representatives have met regularly to "brainstorm" project ideas and/or facilitate the implementation plan for selected activities. Resources in the way of funding, manpower, supplies, etc. are creatively pooled, when possible, to support events. Guam EPA is the lead agency. The group was responsible for successful projects such as the Annual Island Pride Festivals (held in conjunction with annual Earth Week activities), aluminum recycling during the Liberation Day Parade, art contests (environmental themes) involving the island's elementary through high school students, Environment Awareness Campaigns using print, broadcast and televised media, and "Block Party" events promoting environmental awareness.

7.1.5 *Update Rules and Regulations to Support Compliance and Enforcement Action; Increase or Create Fees to Support Increasing Cost(s) of Service*

In order to strengthen enforcement and compliance action, Guam EPA should invest time and effort, pertinent to water pollution control, groundwater protection and management, etc. rules and regulations, to research appropriateness and effectiveness. Current fees should be assessed to compare them to costs of service. Legislation should be crafted to modify fees and statutes accordingly. Public education or informational campaigns should be developed to inform all affected or interested stakeholders.

C. Cost/Benefit Assessment

Section 305 requires the States to report on the economic and social costs and benefits of actions necessary to achieve the objective of the Clean Water Act. Limited information is provided for this reporting period. Guam EPA makes note of the guideline information which will be used to format the 2010 IR.

1.0 COSTS

- *Capital investments in municipal and industrial facilities*
- *Investments in nonpoint source measures*
- *Annual operation and maintenance costs of municipal and industrial facilities*
- *Total annual costs of municipal and industrial facilities*
- *Annual costs to states and local governments to administer water pollution control activities*

1.1 2003- 2005 Annual Operation & Maintenance Costs of Municipal Facility: Guam Waterworks Authority

2003	2004	2005
$47,343,433	$42,248,398	$31,643,468*

* Unaudited. Figure is for nine month period Oct. '04 – Jun '05.

2.0 BENEFITS

- *Improvements in recreational and commercial fishing*
- *Extent of stream miles, lakes acres, etc. improved from impaired to meeting WQSs*
- *Reduced costs of drinking water treatment due to cleaner intake water*
- *Increase in use of beaches and recreational boating due to improved water quality*

D. Special State Concerns and Recommendations

Significant issues that affect Guam's Water Quality Programs include:

- *GWA Stipulated Order for Preliminary Relief*
- *Consent Decree*
- *Military Buildup by 2008*

These key issues present immense personnel challenges to Guam EPA related to compliance enforcement responsibilities and inter-agency coordination to develop critical infrastructure planning timelines and implementation plans. It has been necessary for Agency staff, designated to handle core water division objectives, to shift attention to "critical enforcement tasks" as a result of the first three issues.

Relative to the increase in military presence, besides directly generating much more work for the Guam EPA staff, the urgent and well funded DoD development projects may lure capable and trained Agency staff for more lucrative positions in support of the military

expansion. This will cripple the ability of Guam EPA to fulfill its mandates; in the meantime, work demands will continue to simultaneously increase.

1.0 GWA Stipulated Order for Preliminary Relief

In fiscal year 2003 the Consolidated Commission on Utilities (CCU)[9] settled the lawsuit with the federal EPA by entering into a Stipulated Order under the jurisdiction of the United States District Court of Guam. Under the Order, GWA was required to hire a qualified management team to include a General Manager, Chief Engineer, Chief Financial Officer, and a Compliance Officer (to monitor progress towards implementation of the Stipulated Order). The Order required the Guam Waterworks Authority (GWA) to create an interim financial plan and to petition the Guam PUC for rate relief to fund the financial plan. The cost of the Stipulated Order as it related to the interim financial plan is approximately $225 million. GWA intends to borrow approximately $160 million to fund the capital projects listed in the plan. One of the requirements of the Order is to complete a Master Plan for the water system which will culminate in the development of a final financial plan which, when implemented, will assure that the residents of Guam will continue to receive safe, reliable water and wastewater services for the foreseeable future. The most recent GWA quarterly compliance report can be found using the following link: http://www.guamwaterworks.org/documents/QuarterlyComplianceProgressReport19.pdf

2.0 ORDOT CONSENT DECREE

On February 11, 2004, the Government of Guam (Guam Department of Public Works and Guam Environmental Protection Agency) entered into a Consent Decree (Civil Case No. 02-00022) with the United States of America (U.S. Environmental Protection Agency with the U.S. Department of Justice) in U.S. District Court, Territory of Guam. The Consent Decree is a settlement agreement to resolve issues related to the unauthorized discharge of pollutants from the Ordot Dump to the Lonfit River. The historical and continuing discharge of pollutants to the Lonfit River is a violation of the Clean Water Act (CWA).

The Consent Decree outlines a timeline that the Government of Guam has agreed to follow in completing specific tasks to correct the violation. These tasks include financing the closure of Ordot Dump, siting, design and construction of a new Municipal Solid Waste Landfill Facility (MSWLF) that is fully compliant with Subtitle D of the federal Resource Conservation and Recovery Act (RCRA).

The complete Ordot Closure and ceasing of all discharges was initially targeted to occur on October 23, 2007. The beginning of operations and opening of the new Landfill was targeted for September 23, 2007. These schedules have been modified because of legal issues and financing complications. An update to the status of the Consent Decree, the closing of the Ordot Dump and the opening of a new Guam municipal landfill can be

9 Elected five member Commission that replaced the appointed Board of Directors on January 2, 2003. CCU has oversight over Guam Waterworks Authority and Guam Power Authority.

found at the following link: **Guam Solid Waste Receivership | Gershman, Brickner & Bratton, Inc., Receiver.**

3.0 Military Buildup on Guam

The ***Guam Civilian/Military Task Force*** (GCMTF) was created by Executive Order 2006-10 to create an integrated comprehensive master plan that would accommodate the expansion of military personnel, operations, assets and missions to maximize opportunities resulting from this expansion for the benefit of all the civilian and military community.

In turn, an Environment Sub-Committee to this Task Force has also been created under the lead of Guam EPA. This Sub-Committee must determine environmental concerns and potential environmental impacts of the planned military expansion, including impacts projected to occur off DOD properties. Designated members will provide input to the integrated comprehensive master plan.

The following narrative is Guam EPA's contribution to the document presented by Governor Felix P. Camacho entitled "**CIVILIAN MILITARY TASK FORCE**: Response to Federal Register Vol. 72 No. 44 Announcement Dated March 7, 2007". The (May 2007) document provides comments for inclusion into the "scoping process" for the Environmental Impact Statement / Overseas Environmental Impact Statement (EIS /OEIS) by the GCMTF .

ENVIRONMENTAL IMPACTS
Guam Environmental Protection Agency

The Guam Environmental Protection Agency (Guam EPA) recognizes the need for repositioning of Department of Defense (DOD) forces in Guam and provision of infrastructure to support the increased needs of the DOD. In response to the Notice of Intent by the Department of the Navy to produce an Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) on the impacts of 1) proposed relocation of 8,000 Marines from Okinawa to Guam,

2) facilities for berthing of nuclear aircraft carriers at Guam and

3) placement of an Army Ballistic Missile Defense Group on Guam, the Guam EPA provides the following comments. We request that these be included in scoping input to the development of the Draft and the Final EIS.

Why an "Overseas EIS"?

Previous DOD EIS's for Military Training in the Marianas (1998) and for Relocation of Navy Activities to Guam from the Philippines (1993) were not OEIS's. What are the proposed actions and impacts that are to be "beyond 12 miles " from US shores that are said to trigger the need of an OEIS? Will application of the OEIS lessen the concerns and responsibilities of DOD that would otherwise be addressed in an EIS? Will impacts to the environment of the Commonwealth of the Northern Marianas be addressed equally as those to Guam's environment?

National Defense Concerns Versus NEPA:
What circumstances relative to National Defense would override, modify or cancel the NEPA requirements applied to these proposed actions and the development of the EIS/OEIS?

Cooperating Agencies:
How much will each Cooperating Agency contribute in resources, manpower and funds to this NEPA EIS/OEIS effort?

Infrastructure, Wastewater:
Wastewater collection and disposal systems must comply with Guam EPA Wastewater Regulations. The projected increase in numbers of DOD personnel and families precludes the use of individual wastewater disposal systems. As is implemented elsewhere on DOD properties on Guam, connection to the public sewer system is needed. Partnership of DOD with the Guam Waterworks Authority (GWA) on comprehensive upgrades of total facilities should be part of the DOD expansion. The DEIS must propose and evaluate alternatives that may best serve both the civilian and the military communities on Guam through a comprehensive island-wide approach with GWA. The recent GWA Master Plan was developed to cover the period of the planned military expansion but was done before the information on increased military expansion was available. The EIS/OEIS process should revise the GWA Master Plan to include new military impacts.

If a more comprehensive wastewater collection system for all new or expanded DOD activities in northern Guam cannot be completed in time for planned expansion, the DEIS/OEIS should address this. In such an event, a temporary arrangement of special wastewater treatment facilities, that have effluent of drinking water quality discharged on the site, may be considered, if this can be built and operated to Guam EPA approval, with no impact on the aquifer below. DOD must coordinate with the local Guam Waterworks Authority on the total projected amount of wastewater from the DOD properties that will be treated at the Northern Sewage Treatment Plant. Under the necessary comprehensive approach to all DOD increased activities, extension of sewer facilities to new residential and other areas is needed. Also, plans must be approved to share in the up-grade and maintenance costs of sewer distribution and treatment once the existing DOD Wastewater MOU expires in 2010.

Alternative solutions to treating and disposing of the increase of wastewater from the planned DOD developments need to be addressed. The GWA Northern Wastewater Treatment Plant (WWTP) is out of compliance with its National Pollutant Discharge Elimination System (NPDES) permit from EPA. GWA is trying to make improvements to meet requirements under a Federal Stipulated Court Order. GWA may need to upgrade this WWTP to secondary treatment if Clean Water Act Section 301(h) requirements and water quality standards cannot be met. If the GWA improvements can be supported in the

form of mitigation from the DOD impacts, the necessity and cost of secondary treatment may be avoided, through EPA's agreeing to continue GWA's waiver from secondary wastewater treatment requirements under Section 301(h) of the Clean Water Act.

Infrastructure, Drinking Water:
Plan review for expansion of the drinking water systems to service all DOD facilities will be required by US EPA and Guam EPA. Regardless of their owners and operators, the water distribution systems, including water storage tanks and water line connections must be inspected for compliance to meet Guam and U.S. Safe Drinking Water Standards. Existing capacities, projected needs and recommended approaches to meet those needs should be considered. The impacts of using alternative sources of drinking water should be assessed. These alternatives should consider surface water, ground water, recycled water, desalination and various treatments needed for future water sources and combinations of these sources. Partnership of DOD with GWA on comprehensive upgrades of total water facilities should be part of the DOD expansion. Impacts on Guam's population of such cooperative development of infrastructure versus separate DOD developed and operated systems must be addressed.

The EIS/OEIS process the shall address the cumulative impact of the military build-up on the 2006 Guam Water Resource Master Plan to include the DOD's proposed future developments and evaluate alternatives that may best serve both the civilian and the military communities on Guam through a comprehensive island-wide approach with GWA.

Accelerated replacement of leaking GWA and DOD water lines and development of new planned storage reservoirs should be emphasized to recover and store the lost water in lieu of developing new water sources. Such alternatives must be considered as well as water conservation and recycling.

Groundwater:
A series of assessments on ground water must be carried out as part of the EIS/OEIS. Cumulative impacts of military expansion and relocation on the US EPA recognized sole source aquifer of Guam need to be addressed. Increased pumping from the aquifer for all DOD uses shall be assessed relative to its corresponding sub-basin's sustainable yield. Because of pollution risks to currently utilized ground water resources, the issue of ground water under the direct influence of surface waters (GWUDI) must be assessed and its impact on cost and availability of water to serve the increased needs of expanded population and developments must be evaluated.

Extension of sewer facilities to unsewered developments off federal lands done in a coordinated comprehensive approach with GWA to protect the Guam Northern Aquifer while developing expanded sewer facilities for military customers must be considered. The impact of existing TCE and PCE pollution on production of well water for expanded military needs and the alternatives for removing this pollution as part of the drinking water source development must be considered. The closing of the Tumon-Maui Tunnel

and the closing of the Air Force air stripping facility in Dededo for well water should be reconsidered among alternatives for water production. Replacement of the air stripping facility with a granulated active carbon filter system as used at Guam International Airport for former Naval Air Station contamination clean-up, at two of GWA's water wells and two privately owned water wells, which have been quite successful in the removal of contaminants, should be considered.

Storm Water Management:
The Guam EPA requires that all storm water disposal, up to the 20-year, 24-hour storm event, be contained on-site of the proposed facilities. Permits for and upgrades to stormwater management systems will be required to accommodate the large expected increases to the flows and decreases to quality of the storm water, whether discharged to the ground or to surface waters.. New expansion construction and upgrades to air strips, wharves, roads, parking areas or other impervious surfaces should have management controls consistent with the Government of Guam's legally applied Stormwater Management practices and this must be recognized as part of the mitigation under the EIS/OEIS. Special attention to the Federal Sole Source Aquifer designation of the aquifer under Northern Guam must be included in the DEIA/OEIA. Impacts of deviation by the DOD from practices enforced by Guam EPA for stormwater management, as applied on all non-DOD properties on Guam, must be addressed.

Erosion Control:
All proposed activities involving clearing and grading should comply with best management practices applied throughout Guam. Agency permit fees shall be paid where applicable.

Environmental Protection Plans (EPP) are required for clearing and grading activities. Stormwater best management practices and erosion control measures shall be implemented for construction and post-construction phases. Vegetative waste should be composted, mulched and diverted from the waste stream going to the landfill. Prior to the commencement of earthmoving activities, local government clearances from the Guam EPA (e.g., for water quality impacts) Department of Agriculture (for wildlife and endangered species), Department of Parks and Recreation's Historic Preservation Office (for historical and archeological concerns) must also be obtained.

Quarries:
Expanded demand for quarry materials for military construction and off-base construction triggered by the military developments must be assessed and matched to existing and new quarry sites. Impacts of the uses of the quarries and selection of sites and methods that are least damaging to the environment, and to human and natural resources should be assessed and developed into a comprehensive quarry development plan for Guam. The EIS must propose and evaluate alternative quarry materials sources that may best serve both the civilian and the military communities on Guam through a

comprehensive island-wide partnership (shared development). Production of limestone sand from quarries for all uses of sand should be required, rather than use of submarine and beach sources of sand.

Radon Abatement:
Guam EPA encourages that all new proposed dwellings, dormitories, barracks, classrooms and offices in northern Guam be designed as Radon Resistant New Construction Buildings, since they will be built over limestone topography known to emit unsafe levels of radon gas. Impacts of not doing so should be addressed in the EIS.

Air Pollution:
Impacts of emissions due to potential increase of demands from existing power suppliers or the construction of new power sources, including back-up power sources and waste to energy production, need to be assessed and related to compliance at all potential Guam sites. Impacts of increased vehicle and vessel emissions on Guam air quality should be addressed.

Solid Waste and Construction and Demolition(C&D) Debris:
The AAFB has been successful in reducing and diverting waste, especially green waste, from landfills. Similar and improved new methods to reduce and recycle solid waste should be addressed in the DEIS/OEIS and impacts on landfill requirements noted. Partnership possibilities with private and Government of Guam recyclers should be considered. Assessment and recommendations should be made on limiting landfills to a single, privately operated one for all of Guam, regulated by an autonomous authority. The change to the lifetime of this already planned landfill due to increased waste from the expanded population due to military build-up must be calculated in the EIS. Temporary alternatives on military property should not be proposed without assessment of their impacts on development of the proposed single landfill for all of Guam. The impact of the transportation of increased solid waste to the new landfill facility should also be addressed.

C&D debris from DOD activities should be recycled as much as possible. Capacity to recycle old concrete from demolition sites exists on Guam. If the hardfill material resulting from demolition in DOD projects is to be disposed of off-Base, the current inventory of Guam EPA permitted hardfill sites must be evaluated in the DEIS/OEIS to see if they can accommodate the quantity of hardfill to be generated. If there is not assured capacity, alternatives must be proposed. Alternatives that may best serve both the civilian and the military communities on Guam through a comprehensive island-wide partnership (shared development) for hardfill management should be evaluated. A recycling program encompassing all federal and non-federal activities on Guam should be considered, to include aluminum cans, cardboard, paper, plastics, glass, metals, wood and green waste. Separation and private curb-side collection for recycling of these materials needs to begin very soon and this should be promoted through a joint Military and Government of Guam approach. Impacts of not doing so should be assessed.

A deposit on all white goods, TV's and other appliances, aluminum cans, plastic bottles, and glass needs to be initiated Island-wide, with full commitment of the DOD, to promote recycling.. Or else an alternative means of funding the collection and recycling of these items should be recommended, as is done on Saipan.

Hazardous Waste and Installation Restoration Sites:
Management practices and impacts of hazardous waste, inclusive of waste propellants, explosives, pyrotechnics, used oil; etc. must be addressed. Potential hazardous wastes from construction, demolition, training, restoration and support services must be included.

DOD should have generic contingency plans that should outline procedures that DOD will adhere to in the event that they find adverse environmental conditions during the buildup, this may include but not limited to buried or submerged drums/containers, contaminated soil/water, UXOs, as well as experienced "spotters" that can identify these situations.

Installation Restoration sites such as the Military Munitions Response sites, and the "over-the-cliff" dumping onto Urunao private properties and other clean-ups need to be incorporated in assessing of best alternative development sites. Unexploded ordinance from WWII and other widespread and often unrecorded military contaminants are in jungle areas, submerged lands and currently undeveloped military sites. This can impact site selection and costs of new developments. Known IR sites and timelines for cleanup actions need to be considered in the DEIS/OEIS review of alternative development sites.

Toxic or Environmentally Harmful Chemicals:
Impacts from increases in imports or in generation or storage of toxic chemicals or chemicals that may harm the environment must be addressed.

Pesticides Use:
Impacts of the use of insecticides, fungicides, rodenticides, and microbicides in DOD operations, construction, renovation and maintenance should be addressed. A Pesticides Use Plan should be required for all DOD activities.

Explosives Hazards:
Land use and water use impacts and potential natural resources impacts, especially to native species, from military explosives must be addressed.

Firearms Training Impacts:
For planned location of firearm training areas, the EIS must look into the impact of the noise that may disturb the normal activities of native species as well as human uses of land and waters. Besides land and water uses impacts, impacts to the environment from bullets, shell casings and firearms use residuals must be addressed in the EIS. The impacts of bullets on the marine environment should be assessed over the life of a shooting range. Clean-up of these training wastes must be planned and therefore shooting out to sea can not be acceptable. If an alternative includes shooting over the marine

environment, the methods and costs of removal of bullets from the coral reefs protected by US Executive Order must be addressed.

Beach Landing Training Impacts:
Amphibious landing exercises will have impacts on coral reef conservation, beach and coastal area erosion, and migratory shorebird feeding, and can conflict with other uses of natural resources and land and water areas. These issues all need to be addressed and impacts of all classes of proposed craft in all possible use areas must be separately addressed.

Electromagnetic Radiation Impacts:
Any possible or perceived impacts from electromagnetic radiation related to military activities and possible health and land use impacts must be addressed.

Nuclear Radiation Impacts:
Any possible or perceived impacts from nuclear radiation related to military activities and possible health and land and water use impacts must be addressed. The current level of radioactivity in Apra Harbor (water and submerged lands adjacent to Polaris Point or the Inner Harbor) and the sources of this radioactivity must be assessed.

What types of radioactive monitoring or surveying are done on military installations and at Guam sites external to the bases? What are the types of samples, periodicity of sampling, the isotopes and radiation of concern, and locations of sampling? What monitoring processes are employed? What is the turnaround time for results? What federal and Guam agencies receive these monitoring results?

Will there be a cumulative increase in background radiation levels due to the additional nuclear vessel activities in the Harbor or at the other proposed sites?

Native Species Habitats:
Significant cooperative activities among the DOD, and U.S. and Government of Guam agencies concerned with endangered species and native species conservation have progressed over many years. Habitat areas on DOD property have been used for cooperative conservation projects. The DEIS/OEIS must note impacts to listed species and address protection of their habitats, including providing improved studies and re-evaluation of their habitats near DOD development sites. The EIS must propose and evaluate natural resource conservation alternatives that may best serve both the civilian and the military communities on Guam through a comprehensive island-wide partnership. Management through accepted ecosystem approaches should be described.

Special attention must be given to native Guam tree snails which have been inadequately addressed in previous impact studies. All native tree snails have been badly impacted by human activities, especially removal of vegetation and introduction of alien species. Three of these species are listed as endangered on Guam. For example, the Draft EA for the proposed Beddown of Training and Support Initiatives at Northwest Field, listed tree

snails as "not present ". But one species was recently rediscovered by the Director of the University of Guam Marine Laboratory while performing a study for the Air Force at Northwest Field. This species had not been seen anywhere since its original discovery before its scientific description in 1898 (Reference: Barry D. Smith, 2000, Land Snail Survey of Proposed Cargo Drop Zone at Northwest Field, Andersen Air force Base, Guam).

Loss of vegetation serving as habitat and food sources for endangered tree snails, birds and bats and impacts on native species from all new developments and from DOD related population growth needs attention in the DEIS/OEIS. Information on impacts to Guam species and alternatives and activities to mitigate impacts on these species should be addressed. We believe that a comprehensive mitigation plan is needed in regards to overall impacts on living plants and animals from all the proposed DOD activities. This should include recommendations on mitigation banking possibilities for future impacts. Cumulative impacts to health of ecosystems, including coral reefs, must be addressed. Also, improved management of impacts from introduced species and procedures to prevent new introductions on land and in fresh and marine waters should be addressed.

Apra Harbor Resources:
Impacts of the creation of wharf facilities to berth the CVN, as well as other expanded needs of the Navy, the Marines and the Coast Guard in Apra Harbor will seriously impact the many existing and potential uses of Apra Harbor. Outer Apra Harbor is one of the cleanest harbors in the world, with its clear waters and numerous coral, fish and invertebrate species. Because of the many existing uses occurring in Outer Apra Harbor, a comprehensive conceptual plan for all uses, including the planned new military uses, should be prepared as part of the EIS and its implementation by all users promoted. A partnership approach to such planning among Government of Guam, Federal resource agencies and the DOD will best serve both the civilian and the military communities on Guam and the National interest.

Alternatives to destroying the coral reef shoals in Apra Harbor must be developed and promoted in the EIS to allow a turning basin for the aircraft carriers that will visit Guam. These various shoals, including Western Shoals, Middle Shoals, Dry-Dock Shoals, Jade Shoals, Finger Reef, Sponge Reef and Hidden Reef are beautiful healthy coral areas with highly diverse fish and invertebrate species. These are areas that the tourist industry as well as the local population and military residents utilize for sport scuba diving, and snorkeling excursions. Protection of the shallower shoals from ship groundings and boat damage would be aided by better marking of the various shoals with proper buoys.

Development of deeper artificial reefs in Apra Harbor would not mitigate damage to these shoals. Increases in sea traffic and related restrictions or limitations on commercial and recreational water uses in Apra Harbor must be addressed.

Impacts beyond Inshore Waters:
If the Overseas EIS is being done because developments or changed uses are planned in areas beyond 12 miles from shore, these uses, their alternatives and their impacts should be described. No proposed activities in these waters have been named, but JGPO has said that the reason for an OEIS is because of some kind of activities and impacts will be beyond 12 miles.

Cumulative Impacts:
The Guam EPA has reviewed the scoping needs for the impacts expected from the actions noted in the NOI for the EIS/OEIS, as a separate group of impacts, not encompassing the significant interactive and cumulative impacts of related DOD proposed developments not only to current local conditions, but also to proposed or anticipated local development/growth. The overall cumulative impacts of additional projects and developments directly and indirectly caused by military expansion on Guam need to be addressed as thoroughly as possible in the DEIS/OEIS. For example, some of the many inter-related DOD activities that are ongoing and planned for development on Guam include the redevelopment of munition igloos at Andersen AFB, establishment of Global Hawk activities, the proposed Beddown of Training and Support Initiatives at Northwest Field, the expansion of Kilo Ammunition Wharf, the improvements to support nuclear submarines, the development of on-base schools, associated sports facilities directly related to school activities, library expansion, military education center expansion, facilities outside of the DoDEA school and higher education systems to provide collaborative opportunities and joint program planning for K-16 yet to be determined, barracks, housing and supermarkets, etc.

We request that the DEIS/OEIS include more than summary tables of the ongoing and expected projects. The cumulative and interactive impacts of each proposed project need to be addressed along with local future development/growth. Discussion should be provided on compatibility and interdependency of projects and ways to mitigate overall impacts. Comprehensive approaches to accommodate infrastructure needs and the lessening of any resulting negative impacts overall need to be addressed in light of all DOD activities.

The inclusion of impacts from transient DOD personnel and construction and service workers must be added to impacts of those based on Guam in all issues addressed in the EIS/OEIS.

Cumulative impact analyses should include not only direct impacts, but also impacts indirectly caused by military activities. Many indirect impacts due to the proposed build-up covered by this EIS/OEIS are already occurring, such as increased property sales, production of barracks for construction workers, increased immigration or return of previous residents to Guam, etc. Statistics and projections on these changes and impacts must be generated for the EIS.

The logical reference point for measuring cumulative impacts must be established, such as environmental conditions at a certain point in time, e.g., 2006.

Mitigation:
Previous mitigation by the DOD on Guam and in the CNMI for environmental impacts has not been successful, such as the Navy mitigation for construction of Kilo Wharf. Much improved and permanent mitigation must be planned in this EIS/OEIS. We believe that a comprehensive mitigation plan is needed in regards to overall impacts on living plants and animals from all the proposed DOD activities on Guam. This could include recommendations on mitigation banking possibilities for future impacts. Impacts and mitigation for other islands should also be addressed.

The potential value of determining compensatory mitigation actions through the technique of Habitat Equivalency Analysis (HEA), as is being used for Kilo Wharf expansion mitigation, should be discussed and its application to all DOD projects impacts evaluated.

Mitigation for impacts to the human environment should consider provision of DOD lands for public uses such as recreation or a new public landfill and sharing of DOD resources such as those for mass transportation.

Impacts on Regulating Agencies:
We are particularly concerned over the anticipated impacts of increased military presence on Guam on the ability of Guam Environmental Protection Agency to provide the services which we are mandated to perform under US and Guam laws. The same concerns apply to other Government of Guam regulatory agencies.

Although plans, sites and detailed information on the relatively huge and sudden establishment of new facilities to be addressed in this EIS are not yet available, as well as information on other possible DOD projects and secondary impacts, these must be taken into consideration. Our estimates on anticipated impacts on Guam EPA services can only be general and preliminary at this time, and subject to revision as more information becomes available.

Wastewater:
Whether the DOD develops its own or, as logically expected, uses Guam Waterworks Authority owned and operated wastewater collection and disposal systems, they must comply with Guam EPA Wastewater Regulations. A comprehensive wastewater collection system for all new or expanded DOD activities on Guam needs to be developed and coordinated with the GWA Master Plan, then approved by GEPA. DOD must coordinate with the Guam Waterworks Authority and GEPA on the total projected amount of wastewater from the DOD properties that will be treated by GWA. Sewer connection permits, treated wastewater discharge permits and plans and designs for collection and treatment systems, all need Guam EPA engineers detailed reviews and approvals.

Drinking Water:
Guam EPA will need added resources to review plans for expansion of the DOD drinking water systems and their meeting legal requirements, while not impacting resources necessary for non-DOD water users. The water distribution and treatment systems, including water storage tanks and water line connections must be inspected by Guam EPA for compliance to meet Guam and U.S. Safe Drinking Water Standards.

Clearing, Grading and Excavation:
Most new DOD facilities will involve clearing and grading, which require Guam EPA permits following plans being reviewed by GEPA engineers. An Environmental Protection Plan (EPP) is also required for clearing and grading activities. If surface water may be impacted, a Water Quality Monitoring Plan must be filed with GEPA and approved for each project. Plans for best management practices applied to stormwater disposal and erosion control measures must be reviewed, approved, permitted, and then after construction, monitored by GEPA staff. New expansion, construction and upgrades to air strips, parking areas or other impervious surfaces should have management controls consistent with the Government of Guam's legally applied new Stormwater Management practices. Although the DOD does not apply for Guam Building Permits for construction on Federal properties, the private contractors working on DOD projects do apply for the various GEPA permits. Planned new developments over Guam's federally recognized Sole Drinking Water Source Aquifer will require increasing scrutiny by the already overworked GEPA staff.

Water Quality Certification:
All US Clean Water Act Section 401 permitting is administered by Guam EPA. Related review of wetland permits and of Federal Consistency Approval under the Coastal Zone Management Act are also carried out. Projects from military expansion will increase workloads for all of these.

Solid Waste:
GEPA must permit and regulate landfills that accommodate military expansion, and also must regulate other disposal activities and the expanded waste storage, recycling, waste separation, collection and transfer activities expected. GEPA plays a major role in having future military solid waste management be integrated with the public waste management system and having DOD utilize the new Guam Sanitary Landfill.

Significant amounts of Construction and Demolition(C&D) Debris are expected to be generated by upcoming military developments. This requires development and permitting of new hardfill sites. Even the existing GEPA mandates for regulating and planning for these solid waste activities remain unfunded by the US and by Guam General funds. The added responsibilities for expanded military developments must result in added resources of manpower, equipment and operational funds for GEPA to meet its mandates on solid waste management planning and regulation.

Hazardous Waste and Clean-Up Sites:
Amounts of pesticides and hazardous materials linked to the military expansion will increase on Guam, needing additional Guam EPA resources for monitoring, permitting and enforcement.

Dozens of Installation Restoration (clean-up) sites of hazardous wastes on DOD properties (and overflowing from DOD properties, such as over the cliff at Urunao), as well as off-Base, Formerly Used Defense Sites (FUDS), are recognized. Many more on Guam may be found in the future as resources become available to identify them. These are being assessed and slowly restored to allow safe, but often restricted, uses of at least adjoining properties. GEPA through its DSMOA program plays a key part in promoting and overseeing such clean-up activities. Increased DOD developments will lead to pressure to increase and speed up the investigation and restoration of these hazardous waste sites and will increase generation of new hazardous waste to be managed. This will expand the already burdensome load on GEPA resources.

Air Quality:
Permitting and monitoring of air quality related to increased releases of pollutants from military facilities, vehicles and equipment or private and Guam Government facilities, vehicles and equipment serving increased DOD demands, will increase the demands on already insufficient Guam EPA resources.

Off-Base Impacts:
A very significant increase in off-base population would occur as a result of the importation of labor necessary for construction. Most of the laborers for DOD construction would have to be temporarily brought in to Guam. Housing Facilities for Temporary Workers (Barracks) will cause many impacts involving land use and infrastructure permitting and planning by GEPA staff to mitigate and control. Likewise, related increases in traffic and government services for the imported workers will demand GEPA attention. The DOD may not assume primary responsibility for these impacts, making the work of GEPA even more difficult. The immediate increased demands on water, sewage and solid waste disposal from the influx of new workers will only aggravate the existing severe violations of environmental standards by the Government of Guam, as illustrated by the Federal Court ordered Consent Decree and Stipulated Orders. New road construction has always been a regular burden on GEPA reviewers and permitting staff and this should greatly expand with urgent requirements for roads needed by the military.

The expected DOD construction both off and on Base will require massive amounts of quarried materials that will also lead to more review, permitting and inspection work by GEPA staff. Wherever they are located, military developments, private and public developments triggered by the DOD expansion and even plans for expanded programs, will generate extensive EIA/EIS documents with strict timelines for review and comment. GEPA is already understaffed in manpower able to conduct these reviews and provide required formal comments.

Loss of Qualified Staff:
Besides directly generating much more work for the GEPA staff, the urgent and well funded DOD development projects promise to lure more and more capable staff trained by GEPA to abandon the Agency for more lucrative positions in support of the military expansion. Several extremely important and experienced staff have already made this move in the last year. This is crippling the ability to fulfill GEPA mandates, while the demands and workloads are simultaneously greatly increasing. The EIS may address impacts on the permit processing resources and resulting delays in permit approvals and discuss the secondary impacts and costs resulting from these delays.

Infrastructure, Energy:
Partnership of DOD with GPA versus separate DOD developed and operated systems should be evaluated for impacts to the environment and to customers. New alternative energy options to replace traditional sources of power should be evaluated, such as wind generation, cold seawater air-conditioning, ocean thermal energy conversion, methane from the Ordot Dump, waste-to-energy and solar power. These can prevent increased pollution that would be generated by expanded use of diesel, oil, solid waste or coal as fuel. Military facilities should be designed for energy conservation and existing buildings should be modified to promote conservation.

Due to the many typhoons that Guam experiences, more reliable underground utilities need to be installed and the old system of power poles needs to be removed. In the past, after large storms have hit the island, it has taken from 1 week to more than a month in some of the outlying areas for power to be restored. This is because of wind damage to power lines and equipment. Also, security of these utilities from other threats, such as vehicle accidents or terrorist and vandal actions would be served by relocating them underground. Current technology easily allows underground replacement of above ground lines. Costs and impacts of acceleration of this conversion, on and off DOD property, as related to the military build-up should be addressed.

Infrastructure, Traffic and New Roads:
With approximately 40,000 active duty personnel and dependents added to the island, what additional numbers of government and personal vehicles will be needed? What percentage will be importing their vehicles to Guam? What will be the impact to traffic? What will be the impact to Government of Guam Motor Vehicle Registration and licensing resources and services? All Guam residents anticipate serious problems of increased road traffic accompanying the population changes tied to DOD expansion, and are concerned about development of new roads to link military operations. Much information and detail of alternative roads and their impacts must be covered in the EIS and Guam Highway Master Plans should be updated to coordinate with military road plans.

Potentials for bicycle use on and off base should be assessed and how to meet needs for safe bicycle paths throughout Guam should be considered. Management of stormwater runoff must be incorporated in all plans and designs for new roads and road

improvements. Where new roads are planned, impacts to wetlands and areas of environmental concern must be addressed. Coordination with Government of Guam All regulatory agencies of the Government of Guam will apply their permitting and regulatory responsibilities, as required by US National laws and Guam laws, to the activities undertaken by the DOD and its contractors to support relocation and expansion of the military on Guam. To avoid problems and delays in the progress of the support actions, regular dialog and communication among the DOD, its contractors and Guam agencies, including the Guam Bureau of Statistics and Plans, the Guam Environmental Protection Agency, the Guam Department of Agriculture and the Guam Department of Parks and Recreation should be held. The permits, approvals and consultations needed from Government of Guam Agencies as well as from other Federal Agencies should be noted as part of the draft EIS/OEIS.

Recreational Resources:
Impacts to Water Recreational Resources & Facilities: What numbers of additional active duty personnel and their dependents and military transients will be scuba diving, snorkeling, sailing, fishing, jet skiing, boating and competing with residents and tourists for dive, snorkel, fishing, and vessel use sites? This may be estimated from projections based on current Guam statistics on DOD associated divers and boat owners. Should the Recreational Water Use Master Plan and Recreational/Marine Preserve Permits limit the number of people at environmentally sensitive areas (like they do for Hanauma Bay in Hawaii) to minimize impact to those sites e.g., at Piti Bomb Holes Marine Preserve? Increased impacts on marina facilities and moorings for boat will be impacted and should be assessed. The EIS also should estimate the impact of increased recreational and commercial fishing, due to population increases, to the local fish resources. Mitigation for these increased impacts must be detailed.

Increased use of public areas:
Impacts must be assessed and mitigation planned for increased demands for off-base playgrounds, beaches, parks, picnic areas, sports facilities (soccer, football, baseball, softball, swimming, tennis, basketball, paintball, cock-fighting, volleyball, etc.), hunting areas, camping areas, off-roading vehicle use areas, fishing areas, conservation areas, hiking trails, biking trails and paths, and other public areas. This includes direct demands form military population increases and indirect increased demands from additional population triggered by the Military build-up.

Impacts to animal facilities:
With approximately 40,000 active duty personnel and dependents to the island, how many will be bringing their pets? What is the impact to pet quarantine facilities and veterinarian services?

III. SURFACE WATER MONITORING AND ASSESSMENT

This section includes a description of Guam's monitoring program, a description of the assessment methodology for classifying all surface waters, assessment results, a description of the island's wetlands program, and information on public health issues.

A. Monitoring Program "2006 Comprehensive Monitoring Strategy"

1.0 Monitoring Program Strategy

The United States federal and Guam environmental legislation and regulations all apply in Guam. The Guam Water Pollution Control Act (10 GCA, Chapter 47) mirrors many of the same concerns and requirements of the Federal Water Pollution Control Act. In addition, the Guam Environmental Protection Agency Act (10 GCA, Chapter 45) created the Guam EPA and its Board of Directors in 1973.

There are Guam legal requirements for the classification of waters, establishing standards of water quality, permitting discharging facilities, and public information functions. An additional Guam law, the Water Resources Conservation Act (10 GCA, Chapter 46), requires identification of Guam's significant water resources and the necessary planning, regulation and management of these resources for their protection, conservation and rational development.

The Guam Water Monitoring Strategy (GWMS) was originally implemented in 1978, with the first major adopted revision occurring in 1983. This monitoring strategy is currently directed at the systematic collection of physical and chemical data from fixed locations. The sampling frequencies are maintained at sufficient intervals to assess the various land-use impacts on water quality.

Provisions for biological monitoring were incorporated into the GWMS, but resource limitations hindered the implementation of this program. Reinstatement of the biological program occurred during fiscal year 1998, however river/stream monitoring was suspended (since 1998), and no biological data has been gathered for physical and chemical parameters for seven years (1999-2005). The only portion of the GWMS that has been continuously performed is the Recreational Beach Monitoring. The GWMS underwent a major strategy and implementation revision during fiscal years 2002-2004. The new ***Comprehensive Monitoring Strategy*** *(CMS) was submitted to EPA late in 2005 and initiated that fiscal year. It was presented for the first time in this section of the 2006 Integrated Report.*

Guam EPA and the Department of Agriculture, DAWR are the main agencies engaged in local surface water monitoring. Other related surface water monitoring, research, and assessment activities are conducted in Guam by (but not limited to) the University of Guam (UOG) Water and Environmental Research Institute (WERI), the National Oceanic and Atmospheric Administration (NOAA), the National Park Service (NPS), and Guam Waterworks Authority (GWA).

2.0 Monitoring Goals and Objectives

The goals of the CMS are to:

- Conduct a comprehensive assessment of water quality throughout the island using a rotating basin approach;
- Complete a thorough evaluation of monitoring data;
- Evaluate if the quality of the waters of Guam are suitable for their designated uses;
- Evaluate if the GWQS are appropriate and relevant to present conditions for the waters of Guam; and
- Coordinate new approaches to improving and protecting the island's water resources through the implementation and enforcement of CWA 319 and 6217 programs.

The CMS was designed to compare the GWQS to the prevailing conditions within Guam waters. This is done to insure that the quality of the waters of Guam remains high or improves. Community planners use this data to assess if current water quality standards are suitable for their intended uses. The data is also analyzed for trends in water quality to identify possible sources of pollution and to assess the effectiveness of present treatment practices.

As previously discussed, Guam is divided into two distinct regions, northern and southern. Differing geological and hydrologic features create that distinction. The Surface Water Monitoring Strategy (SWMS) outlined in the overall CMS, focuses on the southern region of Guam where the majority of all surface water features exist.

To meet all federal and local reporting requirements the CMS includes ten distinct individual monitoring plans. The programs developed for each of these plans are:

1. Status and Trends Monitoring Program
2. Guam Environmental Monitoring and Assessment Program
3. Recreational Beach Monitoring Program
4. Wetlands Monitoring Program
5. Fish and Shellfish Consumption Monitoring Program
6. Groundwater Assessment Monitoring Plan
7. Marine Preserve Water Quality Assessment Program
8. Nonpoint Source Pollution Monitoring Program
9. Underground Injection Control Monitoring Program
10. Man-Made Impoundments Monitoring Program

3.0 Monitoring Design

The CMS relies on a variety of approaches in conducting its monitoring and assessments. The most common approach is to measure the chemical and physical constituents in the water itself. The concentrations of these constituents are then compared to appropriate standards to determine if the designated uses of the waterbody are supported. Sampling will also be extended under the CWS to include sediment and biological tissue (macro-invertebrate and fish). While water sampling provides a snapshot of conditions at the time of sample collection, sediment and tissue results provide a view of conditions over a somewhat longer time period.

3.1 STATUS AND TRENDS MONITORING PROGRAM (STMP)

The *Status and Trends Monitoring Program* (STMP) is the current version of the original "Guam Water Monitoring Strategy". The GWMS was the Agency's primary water quality monitoring program for the island; and approved by EPA in 1983. It was internally revised several times over the years.

The STMP incorporates the original GWMS monitoring stations plus additional judgmental stations to increase spatial coverage. The sampling frequency has been standardized via a rotating basin design which is the only major change to the original program.

Two of the three Guam water classification types are assessed: *Surface Waters*, which are rivers and streams, with salinity less than 0.5 ppt, and *Marine Waters*, which are defined as coastal waters with salinity greater than 0.5 ppt. These water classifications are further subdivided into specific geographic complexes or reporting units, based on major river drainage basins/watersheds, including associated coastal receiving waters **(See Appendix A: Figures 2a-2c and Appendix B: Table B1)**. The third water resource is *Groundwater* which is mainly found in the northern portion of the island. Groundwater is monitored and assessed under a separate program.

The design of the STMP is based on a judgmental sampling design within a "Rotating Basin" concept. Four to six resource units (watersheds) are sampled semi-annually, once every eight years. The sampling frequency is six samples per station per index period, resulting in a total of twelve monitoring samples per calendar year for each resource unit. Resource units are then rotated through an eight year cycle.

The first index period on Guam is a dry season which occurs from January through June. The second index period is the island's wet season which occurs from July through December.

The current ranking of resource units is based on the Guam EPA's 2003 Section 303(d) list of impaired waters, which is updated every two years. Those priority watersheds are scheduled during the first four years of monitoring. The watershed monitoring schedule, **Table 6**, correlates with the watershed locations illustrated in **Figure 3, Appendix A.**

Table 6. Status and Trends Monitoring Program: 8-Year Monitoring Schedule

Sample Year	Watershed	# of Stations
2009	Ugum/Apra	14 (72)
2010	Hagatna/Fonte/Piti-Asan/ Taelayag	20 (78)
2011	Pago/Cetti	18 (76)
2012	Tumon/Yigo /Toguan	7 (65)
2013	Agat/Inarajan/Dandan/Asalonso	18 (76)
2014	Northern/Umatac	15 (73)
2015	Togcha/Talofofo	28 (86)
2016	Geus/Manell/Ylig	17 (75)

3.1.1 *STMP Goals/Objectives*

The overall goal of the STMP is to provide the Guam EPA with baseline water quality data to characterize and define trends in the biological, chemical, and physical conditions of the waters of Guam. It is designed to identify new or existing water quality problems and to act as a triggering mechanism for focused studies, investigations, inspections and enforcement, or other appropriate actions by the Agency.

The specific objectives of the STMP are to:

1) Identify, document and predict the conditions of Guam's water resources.
2) Assist in determining the status of an ecosystem's "environmental health".
3) Establish the water quality of aquatic reference sites for comparison with affected surface water , groundwater, and ecosystems.
4) Document potential problem areas.
5) Identify water quality changes over time in pertinent waterbodies.
6) Provide information to managers, legislators, agencies and the public.

To meet its environmental goals and objectives, the STMP integrates a combination of biological, chemical, physical, and toxic parameter indicators to monitor and assess site specific water quality conditions, along with island-wide long term water quality trends. All parameters are listed and detailed in **Appendix C**.

Assigned designated uses for these watershed units are: drinking water consumption (with and without treatment), aquatic life support and propagation, primary/whole body contact recreation, secondary/limited body contact recreation, and aquatic life consumption.

Some confirmed and possible sources of pollution in these resource units are development (increases in impervious cover), construction (anthropogenic disturbances), erosion, non-point (run-off) and point source (sewage) pollution, increases in feral animal and wildlife populations, agriculture-use, aquaculture-use, and physical disturbances to riparian vegetation and sandy and rocky coasts.

3.2 Guam Environment Monitoring and Assessment Program (GEMAP)

The *Guam Environment Monitoring and Assessment Program* (GEMAP), or the island-wide probability-based assessment, will be the primary monitoring tool for assessing and describing the general water quality for Guam. The program is designed to assess and determine to what extent the waters of Guam meet CWA goals and assigned designated use classifications and water quality standards. The assessment data is then compiled and reported as a portion of Guam's biennial CWA Section 305(b) Report to Congress.

By randomly sampling surface and marine water resources, Guam EPA can assume that all segments of the resource have equal probability of being sampled and therefore, "the sample set is an adequate measure of the resource in that reporting unit". The advantage of random sampling is that unbiased answers to questions can be presented with known statistical confidence.

Guam EPA will be conducting probabilistic monitoring in Surface Water and Marine Water, but with specific limitations. The surface waters will be further characterized as all "wadeable" rivers and streams having salinity less than 0.5 ppt and monitored under the **Guam Wadeable Stream Assessment** program. The marine waters will be described as all coastal waters from the mean low water mark to a depth of 60 feet, with a depth exemption for Apra Harbor, and having salinity greater than 0.5 ppt. These marine waters will be monitored under the **Guam Coastal Assessment** program.

The sampling frequency for each resource type will be rotated every other year to achieve complete coverage of the island during the CWA Section 305(b) reporting cycle. **Refer to Table 7.**

Table 7. Guam EMAP: 10-year Monitoring Schedule

Sample Year	Resource Type	# of Stations
2005	Marine Waters*	50
2006	Surface Waters*	38 (+ 10 repeats)
2010	Marine Waters	50 (10% 2005 repeats)
2011	Surface Waters	50 (10% repeats)
2012	Marine Waters	50 (10% repeats)
2013	Surface Waters	50 (10% repeats)
2014	Marine Waters	50 (10% repeats)
2015	Surface Waters	50 (10% repeats)
2016	Marine Waters	50 (10% repeats)
2017	Surface Waters	50 (10% repeats)

The Guam EMAP is based on US EPA's EMAP program that advocates a survey sampling design using "Geographic Information System (GIS) technology to probabilistically generate sampling locations". GEMAP utilizes this same probabilistic, stratified-random sampling design for each resource type, with each resource having its own design. Initially Guam EPA will receive 50 randomly chosen monitoring sites from EPA-ORD for both resource types. In each succeeding assessment year, GEPA will

receive 45 new stations and repeat 5 previous stations (10%) for Quality Assurance/Quality Control for the program (**Figure 4. and 5., Appendix A,** and **Tables B2. and B3., Appendix B).**

The design criterion for Marine Waters is all waters from the mean low water mark to the 60 foot depth contour. The exemption to this criterion is Apra Harbor, a special study area for Guam. Within Apra Harbor, a modified sampling procedure will be utilized to allow for sampling only for water column and sediment chemistry at depths greater than 60 feet. The marine waters assessment will be conducted during the Island's wet season, July through December, in even numbered years.

The surface water assessment criteria will be based on the wadeable perennial stream channel of each river or stream. A center location will be plotted and a total reach length of 150 meters will delineated. The assessment will be conducted during the Island's dry season, January through June, in even numbered years.

All methods for sample collection, handling and processing will follow documented EPA standard operating procedures. The Agency will coordinate the data collection and management while adhering to all QA/QC procedures throughout each step of the project.

3.2.1 *GEMAP Goals*

The goals of Guam's EMAP program are:

1) To assess the physical, biological, and chemical condition of Guam's Surface and Marine waters using standardized methods and a suite of environmental indicators;
2) To rank the relative importance of various stressors on the affected resource types;
3) To develop the Surface and Marine EMAP locally; and in the future, assessing neighboring island surface and marine water quality throughout the Marianas;
4) To build partnerships among implementing agencies for more effective future monitoring and assessment.

Data analysis and interpretation will be a joint effort between personnel from Guam EPA and EPA EMAP to facilitate capacity building within the Agency.

3.2.2 *Guam Wadeable Stream Assessment (GWSA)*

The Surface Water EPA EMAP protocols were originally designed for temperate eco-regions and biota, and not a tropical island environment like Guam's. There is no current designated eco-region for Guam or for the Western Pacific. During the first year of the GWSA, Guam EPA will conduct a demonstration project to adapt the temperate assessment protocols and indicators to those more appropriate to Guam. Once these adapted protocols are established (for Guam), they can be exported for use in the state of Hawaii, the remaining U.S. Pacific Flag Islands (American Samoa and the Commonwealth of the Northern Marianas), as well as the Federated States of Micronesia and the island nation of Palau. This project would also be an opportunity for EPA to establish protocols and collect valuable data to help establish an eco-region for tropical

islands in the Western Pacific.

Guam's 97 rivers and streams, totaling 228.65 miles, are located throughout the island's 19 central and southern watersheds **(Figure 5, Appendix A).**

The following is a general list of Indicators. See **Appendix C.** for the complete list.

- general water chemistry
- EMAP physical habitat parameters/ stream discharge measurements
- periphyton community structure and abundance, biomass, chlorophyll
- fish community structure and abundance
- macroinvertebrate community structure and abundance
- fish tissue chemistry/contaminants
- rapid habitat and visual stream assessments

3.2.3 *Guam Coastal Assessment (GCA)*

The GCA is based on procedures and methods adapted from the 2001 State of Hawaii EMAP (HEMAP) documents and the 2001 EPA National Coastal Assessment (NCA). Following the HEMAP and the NCA plans ensure that the GEMAP will be consistent with national EMAP activities while taking into account reviewed and approved modifications for island environments. The environmental parameters to be assessed are a subset of those recommended by the NCA program. They are outlined below and explained in the Guam Coastal EMAP QAPP 2003.

Major modifications to the parameter list are: the substitution of the traditional fish trawls (which are very destructive to coral reef communities) with visual census protocols in conjunction with reef and pelagic fish standing stock coefficients; the substitution of a species of sea cucumber or crab, for the collection of fishes for tissue analysis and as gross pathology analyses and tissue contaminant analyses. Another unique assessment included in the GCA, is the benthic habitat and community assessment for macroinvertebrates, marine algae and benthic infauna, which was adapted from the HEMAP.

The GCA parameters that are similar to the NCA are the water column nutrient, sediment and tissue chemistry, and the identification of soft bottom community organisms. Parameters that were added include fish biomass estimates, storm wave impact estimates, percent cover of macroalgae, and water column analyses of bacteria. An additional parameter under consideration for future monitoring is coral disease identification. **(Refer to Figure 4, Appendix A; Table B2, Appendix B; and Appendix C.)**

3.3 **Recreational Beach Monitoring Program (RBMP)**

Guam's subtropical climate allows for year-round recreation at all beaches, and fishing occurs from both along the shoreline and offshore. The majority of this type of recreational activity occurs along stretches of sandy beaches or limestone plateaus easily accessible from shore. These waters are classified as "M-2 waters" or "Good" under the GWQS. To monitor and test for the designated use "Whole Body/Primary Contact", weekly water grab samples are collected and tested for the approved EPA bacterial

indicator. The presence of elevated levels of these microbial organisms has been proven to indicate diseases such as gastroenteritis, hepatitis, and cholera. The most common of these swimming-associated diseases is gastroenteritis (NRDC, July 1996). Symptoms of this disease include vomiting, diarrhea, headache, and fever (basic flu-like symptoms); and those at greatest risk are the young and elderly swimmers and swimmers with compromised immune systems.

Guam EPA uses the national standards of 35 enterococci/100mL(geometric mean indicator density based on five (5) samples collected over a 30 day period) and 104 enterococci/100mL (instantaneous indicator density based on a single sample) (EPA440/5-84-002). These standards translate to the probability that within the United States, nineteen (19) swimmers for every one thousand (1,000) will show signs of illness (NRDC, July 1996).

The designated use "Whole-body contact/primary contact" means the use of surface water for swimming or other recreational activity that causes the human body to come into direct contact with the water to the point of complete submergence. It is likely that ingestion of the water will occur under this designated use, and sensitive body organs, such as the eyes, ears, or nose may be exposed to direct contact with water. "Whole-body contact/primary contact" designated uses include, but are not limited to swimming, wading, water-skiing, skin and scuba diving, surfing, motorized water sport activities, and fishing.

The designated use "Limited-body contact/secondary contact" means the recreational use of surface water that causes the human body to come into direct contact with the water, but normally not to the point of complete submergence, i.e. wading or boating. It is not likely that ingestion of the water will occur under this designated use, and sensitive body organs such as the eyes, ears, or nose will not normally be exposed to direct contact with the water.

Bacteriological data has been collected by Guam EPA under the Recreational Beach Monitoring Program (RBMP) for over 20 years. The number and the location of stations have varied over the years. As a result of the newly enacted Beach Act grant requirements, a new inventory of Guam's beaches was conducted. The inventory yielded a total of 113 beaches; and of this total, seventy-three (73) beaches were categorized as accessible and warranted inclusion into the RBMP. These 73 beaches were subsequently prioritized into three tiers, using the following criteria.

Tier 1 Beaches: Beaches that are easily accessible, highly visited, characterized by a high number of possible pollution sources, and require frequent monitoring.

Tier 2 Beaches: Beaches with restricted accessibility, beaches that are less frequented, beaches characterized by a few pollution sources that do not require constant monitoring.

Tier 3 Beaches: Beaches classified as remote and/or very inaccessible, beaches that are rarely visited and not usually monitored.

Of the seventy-three (73) accessible beaches, thirty-nine (39) were further classified as Tier 1 with the remaining thirty-four (34) classified as Tier 3 **(Refer to Figure 6, Appendix A and Table B4, Appendix B)**. During the ranking procedure several beaches were technically classified as Tier 2. However, these particular beaches were reclassified as Tier 1 because of their accessibility (by samplers) and their inclusion would not be detrimental to the program.

All Tier 1 beaches are located in waters classified in the GWQS as Good/M-2 (Whole Body Contact), with the exception of two beaches (Outhouse Beach/N18 and Port Authority Beach/N-20) located in Fair/M-3 (Limited Body Contact) waters. Excellent/M-1 (Whole Body Contact) waters are located along the northern coasts of the island which are mostly inaccessible to the public. These coasts are either under military or private control, access is physically barred by the environment, or no public beaches are located within these waters.

In 2005, four new beaches were added to bring the official total of monitored (Tier 1) beaches to 43. On May 19, 2005, station S1-Rizal Beach was officially dropped from the monitoring list because access was restricted. The current number of monitored beaches under the RBMP is forty-two (42).

Swimming advisories are issued based upon either an instantaneous concentration of 104 MPN/100mL or a geometric mean concentration of 35 MPN/100mL, over a five week period. All advisories are released and/or reported weekly, prior to the weekend, via print, radio, and television media to local government agencies, private individuals, and finally posted on the Guam EPA official web page: Guam Environmental Protection Agency -- Guam EPA

Data collected weekly from fixed sampling sites along selected stretches of coastline is used to advise the public against swimming in waters exceeding bacterial standards. The weekly press releases identify those beaches where indicators in weekly water samples exceed water quality standards.

Trend analysis (using the weekly data) is used to characterize risks of exposure to contaminated waters. Resulting trends allow for the ranking of beaches which enable biologists to determine the need for further monitoring or the need to include additional unmonitored beaches to the list.

RBMP personnel conduct annual reviews of all prioritized and monitored beaches to ascertain their continued inclusion in the original RBMP tier. All reprioritization information is forwarded to EPA's Beach Watch Program during the annual Beach Survey period.

The annual prioritizing criteria are:

- proximity to potential pollution sources
- intensity of use by the public
- ease of accessibility by the public
- public input
- best professional judgment of Guam EPA staff

Wednesdays are targeted for sampling to allow for laboratory analysis and re-sampling if required. Samples are collected in the morning hours to obtain microbial concentrations prior to prolonged exposure to sunlight. This allows a more conservative approach to public health protection.

3.4 Wetlands Monitoring Program (WMP)

No strategic program has been developed to monitor the "overall health" of wetlands in Guam. However, Guam EPA recognizes the need for this type of monitoring and has included wetlands as a resource to be monitored under the comprehensive monitoring strategy. Annual monitoring parameters should include mapping areas, hydrologic regimes, water quality, and biological integrity. While physical and chemical criteria for wetlands exist, the Agency has not adopted these criteria or the methods for the biological assessment of wetlands. Guam EPA expects to develop and adopt wetland specific criteria in the future and subsequently implement a WMP.

In the meantime, partnering organizations such as WERI provide water and energy resources information by conducting basic and applied research in an interdisciplinary environment, training students, and disseminating research results.

Graduate students are instrumental in gathering data for WERI's wetlands program. A project has been funded by the Government of Guam, Bureau of Planning aimed at developing a geochemical-sedimentation model that describes the flux of metals and nutrients being stored and moving through a perennial palustrine wetland downslope from a large tract of badlands. The study involves establishing hydrologic parameters, measuring slope retreat and sediment throughput out of the badlands, and chemically analyzing surface runoff and wetland pore waters, the latter through a gridded lysimeter array in the wetlands. Preliminary analysis of pore waters indicates that the wetlands are mobilizing and storing iron and manganese that enter from the badlands via groundwater seepage and in suspension. Concentrations of those metals may exceed three orders of magnitude beyond normal Guam river waters. Future related research will involve a) analyzing geochemical cycling in tidal riverine and estuarine wetlands, b) quantifying badlands denudation rates, c) studying geochemical reactions involving manganese and iron in the wetlands and downstream at the coast where they are co-precipitate on reef debris. For more information about WERI wetland projects visit **www.weriguam.org**.

3.5 Fish and Shellfish Contaminant Monitoring Program (FSCMP)

The Guam EPA proposes the conduct of fish and shellfish tissue monitoring to assess tissue quality for consumption and to determine the need for consumption advisories. Currently, a comprehensive fish and shellfish consumption advisory program (as proposed) does not exist on Guam. The tissue monitoring effort will involve the collection of fish and shellfish tissue samples from recreational, commercial (including imported fish and shellfish), and subsistence fish and shellfish harvesting sites (inland and along Guam's coast) for analyses of priority pollutants.

The contaminant levels in fish will be monitored via a cooperative program among the Guam EPA, the Department of Agriculture/DAWR and the Guam Department of Public Health & Social Services (DPHSS). Guam EPA will collect and analyze the samples, DAWR will determine appropriate species for sampling and sampling locations, and DPHSS will issue advisories needed as determined by the sampling effort.

3.5.1 *FSCMP Objectives*

The objectives of the *Guam Fish and Shellfish Contaminant Monitoring Program* (FSCMP), based on the EPA National 3-tier Guidance, are:

- To investigate and detect the presence and build-up of toxic and potentially hazardous substances in fish and shellfish, encompassing both fish toxicity and public health implications.
- To determine the impact of fish contaminants upon the suitability of aquatic environments for supporting abundant, useful, and diverse communities of fish life in coastal areas of Guam.
- To aid in the location of sources of toxic material discharges and evaluate long-term effects of source controls and land use changes.

Either of two standards will be used in the analysis of whole fish data:

1) Risk-based criteria adopted by the FSCMP; or
2) Recommended screening values (SVs) for certain target analytes for recreational and subsistence fishers (EPA 823-B-00-007, November 2000).

Guam will also use these standards in the issuing of sport fish consumption advisories.

The partial parameter list for the FSCMP is:

- Dieldrin
- SDDT and Analogs
- Aldrin
- Endrin
- Methoxychlor
- Heptachlor
- Heptachlor Epoxide
- Lindane

- Benzene Hexachloride (BHC)
- Toxaphane
- Mirex
- Hexachlorobenzene (HCB)
- Polychlorinated Biphenyls,
- Chlordane
- Mercury

Whole fish data will be used primarily for detecting trends and new contaminants not routinely analyzed. As new contaminants are identified and trends in the concentration of routine contaminants are defined, the program shall adjust its sampling to meet these changes.

3.5.2 *FSCMP Network Design and Rationale*

The design and rationale for this program are being developed and will follow the EPA national guidance for fish and shellfish consumption advisories. If projected funding and staffing are allocated, the FSCMP is expected to be fully developed and implemented within the next reporting period. Projected monitoring sites and species will be based upon the fishing areas designated by the DAWR Inshore Creel Survey. These monthly surveys collect data on the fish species, quantity, and method-of-capture by local fisherman island-wide.

3.6 Marine Preserve Water Quality Assessment Program (MPWQAP)

On May 16, 1997, Public Law 24-21 was implemented creating five (5) marine preserves and making changes to Guam's fishing regulations. The names of the preserves are the Pati Point Preserve, the Tumon Bay Preserve, the Piti Bomb Holes Preserve, the Sasa Bay Preserve, and the Achang Reef Flat Preserve. **(Figure 7, Appendix A.)**

With the enactment of P.L. 24-21, DAWR was required to monitor if observable increases in food fish density and diversity within the established marine preserves could be seen versus non-preserve (control sites) areas. The three "control sites" are Asan Fore Reef slope, Cocos Fore Reef and Lagoon and Pago Bay. A special sub-study area within the Piti Bomb Holes, the Piti Underwater Observatory, began in January 2001.

The fish survey methods include "Strip Transect", Visual Timed-Swim Surveys" and "Video Transect Techniques." Transects are situated on reef flats by habitats (sandy bottom, seagrass beds, and coral/rubble fields) and on the fore reef slopes by depth (-20, -30, -40, and -50 foot contours). All data collection and analyses are conducted and completed by the DAWR. Detailed information about Guam's Marine Preserves and respective studies conducted by the Division of Aquatic Wildlife Resources are available at **www.guamdawr.org/aquatics/mpa.**

During a recent program review, preliminary data showed that food fish density and diversity within the five established marine preserves has dramatically increased over

those in the non-preserve areas. It was also identified that there was a lack of water quality data for all marine preserves. To address this data gap, Guam EPA intends to assist DAWR with the collection of water quality data at all fish survey transect sites within the marine preserves as well as all non-preserve sites.[1] Quality monitoring stations will be co-located with current fish survey transects. A total of 84 water quality monitoring stations will be located at the mid-point (25 meter mark) of each fish survey transect. **(Refer to Table 8).** All monitoring stations will have GPS coordinates recorded.

Table 8. Co-located Fish Transect and Water Quality Locations for MPWQA

Marine Preserve Sites				Non-Preserve (Control) Sites			
Site	**Sampling Location**		**# of Samples**	**Site**	**Sampling Location**		**# of Samples**
Piti Bomb Holes Preserve	FRS	20-30 ft	2	Asan Bay	FRS	20-30 ft	2
		40-50 ft	2			40-50 ft	2
	Flat	Seagrass	1		Shore	Rivers	1
		Coral/Rubble	1	Cocos Lagoon	Flat	Seagrass	1
		Channel	1			Coral/Rubble	1
		Observatory	1			Channel	1
	Shore	Rivers	3		Shore	Rivers	1
Achang Reef Flat Preserve	FRS	20-30 ft	2	Cocos Fore Reef	FRS	20-30 ft	2
		40-50 ft	2			40-50 ft	2
	Flat	Seagrass	1	Pago Bay	Flat	Seagrass	1
		Coral/Rubble	1			Coral/Rubble	1
	Shore	Rivers	8		Shore	Rivers	1
Tumon Bay Preserve	FRS	20-30 ft	3	Tumon Bay Control	FRS	20-30 ft	3
		40-50 ft	3			40-50 ft	3
	Flat	Sand	3		Flat	Sand	3
		Coral/Rubble	3			Coral/Rubble	3
		Coral	3			Coral	3
	Shore	Rivers	0		Shore	Rivers	?
Total Samples:			**40**	Fouha Bay	FRS	20-30 ft	1
						40-50 ft	1
					Flat	Coral/Rubble	2
					Shore	Rivers	1
				Double Reef	FRS	20-30 ft	1
						40-50 ft	1
				Western Shoals	Harbor	20-30 ft	1
						40-50 ft	1
				Facpi Point	FRS	20-30 ft	1
						40-50 ft	1
				Total Samples:			**42**

Two monitoring stations will be established for each fore reef slope site, one between the -20 and -30 foot transects, and one between the -40 and -50 foot transects. One monitoring station will be established for each cluster of transects on the reef flat (e.g. 1 station for a cluster of three coral/rubble transects). Stations will also be located at the

1 Table 8 presents sampling locations for only three of the marine preserves. Physical constraints for **Pati Point** prohibit access and regular monitoring (i.e. limited accessibility due to Department of Defense restrictions; boat launching and tide situation hardships). Based on professional experience, the monitoring staff finds the **Sasa Bay** water quality as too silted for legitimate water quality work.

mouth of the rivers in the preserve and non-preserve areas. DAWR will provide GPS coordinates for each station. Stations will be monitored monthly (if possible, otherwise quarterly) for the standard water chemistry parameters outlined below and listed in **Tables C1 and C2 in Appendix C.** Reef flat stations will be sampled at high tide.

Water quality sampling procedures follow those outlined in the Guam Coastal Assessment Program for data comparison and analyses. The sampling procedure is as follows: Discrete grab samples will be collected using a horizontal Van Dorn sampler or a similar product at 0.5 meters from the surface and 0.5 meters from the bottom for stations less than 2 meters in depth. For stations greater than 2 meters in depth, samples will be collected at 0.5 meters from the surface, mid-depth and 0.5 meters from the bottom. Parameters that will be analyzed are Bacteria (enterococci), Conductivity, Nitrate-nitrogen, Chlorophyll a and Pheophytin a, Ammonium, Total Nitrogen, Ortho-Phosphate, Total Dissolved Phosphorus, pH, Total Dissolved Solids, Total Suspended Solids and Dissolved Oxygen. All water quality samples will be analyzed by the Guam EPA Laboratory and adhere to all EPA and Guam EPA QA/QC requirements.

For *in situ* water quality measurements using a Hach Data Sonde or similar product, stations with less than 2 meters depth readings will be recorded every 0.5 meters. Stations with greater than 2 meters, but less than 10 meters, depth readings will be recorded at 0.5 meters from the surface and 1 meter intervals until 0.5 meters from the bottom. Stations that have a depth greater than 10 meters but less than 20 meters will have a sampling profile of 0.5 meters from the surface and 1 meter intervals until 10 meters, then 5 meter interval until 0.5 meters from the bottom. Parameters that will be analyzed are Conductivity/Salinity, Depth, Dissolved Oxygen, pH, Temperature, Turbidity (NTU) and Transparency/clarity (Secchi Visibility).

3.7 Special Studies Monitoring 2006-2007

Outside the scope of specific annual programs are special studies performed under ongoing environmental programs within Guam EPA or in partnerships with other Agencies. These studies range from specific contaminant investigations to the monitoring of non-point source watershed projects. During the reporting period such studies included but are not limited to:

3.7.1 Guam EPA – Primary Screening for Chemicals of Environmental Concern in Guam's Coastal Waters, 2007

Project Objective: Deploy SPMDs three times over a year at eight hotspot areas around Guam to verify the presence/absence of chemicals of environmental concern.

Historically, water quality monitoring on Guam has been carried out by the Guam Environmental Protection Agency (GEPA) and limited to microbiological and physical/chemical analyses. A toxic monitoring program was incorporated into the island's monitoring strategy but was only conducted on a project-by-project basis. This resulted in large data gaps for Chemicals of Environmental Concern (CEC). This project tried to address this CEC data shortage by conducting a primary-level screening

monitoring using Semi-Permeable Membrane Devices (SPMD) in lieu of tissue samples. The SPMD's will passively collect and estimate dissolved concentrations of CEC's (e.g. hydrophobic organic contaminants such as organochlorine and organophosphate pesticides, and PCBs) at eight specific sites around the Island of Guam.

SPMDs have been designed to passively imitate the biological processes that take place in aquatic organisms which bioconcentrate hydrophobic organic compounds. They are constructed from a lay flat low-density polyethylene (LDPE) tubular membrane with pore sizes less than 10 Å in diameter. The membranes are then filled with one gram of triolein, a neutral lipid commonly found in aquatic organisms, which then sequester the chemicals. Several of these tubes are then placed in stainless steel carriers for deployment or for long term storage in canisters filled with argon gas.

Three 30-day exposure deployments occurred once during the wet and dry seasons and once during a transition period between seasons. After the deployment period, all SPMDs were repackaged and sent to an off-island laboratory for dialysis and analyzed using either GC/MS or GC/ECD techniques.

3.7.2 ***Water and Environmental Research Institute – 2006***

Report Number 113: *Impact of Metal Enriched Leachate from Ordot Dump on the Heavy Metal Status of Biotic and Abiotic Components in Pago Bay* (Authors: Walter C. Kelly III, H. Rick Wood, Yuming Wen)

Pago Bay was suspected of being the final resting place for heavy metal contaminants discharged into the Lonfit River from the Ordot Dump. The findings of the study are discussed with reference to heavy metal levels previously determined in water and sediments from the Lonfit River and in leachate from the Ordot Dump. They are also compared with values for clean and polluted coastal sediments and biota from tropical environments elsewhere. It was concluded that metal concentrations in the biotic and abiotic components of Pago Bay are generally low by world standards and largely reflect natural contributions associated with the alluvial discharges from the Pago River (volcanic detrital material), and groundwater intrusion.

The study clearly demonstrates that Pago Bay is not a permanent sink for sediment bound metal contaminants mobilized downstream from the Ordot Dump. The authors concluded that any contaminated sediments deposited in and around the river mouth, the reef channel and the southern half of the bay during a normal wet season, are re-suspended and flushed from the system by major storms (typhoons) that approach the eastern side of the island. Under such conditions, the reef channel serves as a conduit for their transportation and dispersion into offshore waters beyond the reef margin. Thus the climatic and topographic characteristics of the area combine to provide an effective means of periodically flushing out pockets of contaminated sediments from the entire watershed into the ocean. **(http://weriguam.org/docs/tr_113.pdf)**

3.7.3 ***Water and Environmental Research Institute – 2007***

Report Number 121: *Background Fluorescence in Guam's Coastal Waters* (Authors: S. Michelle Hoffman, John W. Jenson, David C. Moran, Gary R. W. Denton, H. Rick Wood, H. Len Vacher)

The study described herein determined background levels of four fluorescent dyes (optical brighteners, sodium fluorescein, eosine Y and rhodamine WT) in Guam's coastal waters. The primary objectives were to: (1) provide a baseline for future dye trace surveys in tropical karst environments; (2) make recommendations with respect to dye and sampling site selection, positive detection criteria and background correction; and (3) re-examine previous dye trace studies on Guam based on the results of this study.

Guam sample data revealed that optical brightener concentrations were consistently two orders of magnitude greater than either fluorescein or rhodamine. Eosine was rarely detected. Background levels in seawater accounted for nearly 40%, 90% and 25% of optical brightener, fluorescein and rhodamine levels, respectively, detected at the thirteen sampling locations.

Findings suggest that surface runoff rather than submarine groundwater discharge exerts the greatest influence on background levels of fluorescence. Accurate detection of dyes is hampered during the dry season, and by background levels in the surrounding seawater. Recommendations for future dye trace studies are presented and discussed.
(http://weriguam.org/docs/Hoffman_Tech_Report_%20No121.pdf)

Report Number 117: *Developing A GIS Based Soil Erosion Potential Model of the Ugum Watershed (*Authors: Dr. Shahram Khosrowpanah, P.E., Dr. Leroy F. Heitz, P.E., Dr. Yuming Wen, Michael Park)

Soil erosion is defined as the physical degradation of the landscape over time. The process is initiated when soil particles are detached from its original configuration by erosive forces such as rainfall. The soil particles may then be transported by overland flow into nearby rivers and oceans. Prior research has demonstrated that large sediment loads damages the coral reefs (Rogers 1990).

Current developments in geographic information systems (GIS) make it possible to model complex spatial information. A GIS is used in this project to determine how soil erosion potential varies throughout a watershed. Hydrological data is also analyzed to give some understanding of the watershed response to the primary erosive input: rainfall. The two goals of this research project were: 1) to develop a GIS - based soil erosion potential model of the Ugum Watershed, located near the southern village of Talofofo, Guam and 2) to develop a correlation between recorded rainfall, stream flow, turbidity and suspended sediment concentration.

In addition to developing the GIS model, a preliminary hydrological analysis was conducted. Recorded data for rainfall, stream flow, turbidity levels, and suspended

sediment concentration levels were compiled and graphically analyzed. General trends were examined by correlating one hydrological variable with another.
(http://weriguam.org/docs/Park%20Tech%20Report%20No.%20117.pdf)

4.0 Core and Supplemental Indicators

Core indicators selected to represent each applicable designated use are discussed in the ***Comprehensive Monitoring Strategy*** (CMS), **Appendix E** and ***CMS Parameters***, **Appendix C**.

5.0 Quality Assurance Program and Quality Management Plans

The EMAS Division Administrator serves as the Quality Assurance Officer for the agency and coordinates the internal quality assurance program. The laboratory quality assurance program encompasses every aspect of the laboratory analysis from container preparation through the actual data release from the Analytical Services Laboratory to the programs. Analytical Services has developed quality control manuals which detail the operation of the quality assurance program. The elements of quality control addressed in the manuals include organization and sample chain of custody; personnel training; quality control of laboratory services, scope and application, equipment and supplies, reagents, standards, methodology, preservation and storage, calibration, performance criteria and quality assurance, and waste management.

The overall laboratory quality assurance program is in compliance with all USEPA guidelines and is noted in the manuals. The Guam EPA laboratory performs replicate analyses, positive test controls; media control tests, equipment control tests, etc., as required by EPA Laboratory Certification and Evaluation guidelines for Microbiological samples. In addition, the laboratory also participates in annual Water Supply and Water Pollution Proficiency Testing Programs. All Guam EPA personnel who collect samples that require field testing participate in a Proficiency Testing Program administered by Guam EPA.

The laboratory analyses are conducted according to the List of Approved Test Procedures in the Federal Register, Volume 49, No. 209, October 26, 1984; Federal Register, Volume 59, No. 20, January 31, 1994; and Federal Register, Volume 67, No. 205, October 23, 2002.

The Guam EPA QA/QC officer ensures that proper containers are selected for sampling as well as the proper preservation and an adequate volume collected. Sample chain of custody procedures are strictly adhered to in order to ensure that sample integrity is maintained. An accurate record is needed to trace the possession of each sample from the time of collection to analysis. Guam's quality management plans and quality assurance program/project plans are described in the following.

5.1 Quality Assurance (QA) Program

The goal of the QA Program at the Guam EPA laboratory is to provide data which meets or exceeds the data quality objectives associated with each project that passes through the laboratory. This is achieved through the implementation of quality assurance and quality

control measures designed to improve the level of quality of all operations within the laboratory, from sample acceptance to sample handling, and from analysis to reporting. Guam EPA laboratory staff recognizes that the data they generate must be legally defensible. To ensure data is legally defensible, the QA Program emphasizes the implementation of quality control processes, which identify, control, correct, and prevent quality problems, rather than simply to detect and make subsequent corrections. The QA Program is used to demonstrate attainment of a state of statistical control, and to demonstrate that the data generation system produces data that are scientifically valid, traceable and retrievable.

Guam EPA laboratory implements the following practices as part of its QA program:

- Strict adherence to principles of good laboratory practice such as the use of legible handwriting; the use of indelible black ink; and single line, initialed and dated corrections.
- The consistent use of Standard Operating Procedures. The laboratory uses program specific approved methodologies (e.g., approved drinking water methods for the drinking water program). Standard Operating Procedures specific to the laboratory instrumentation and equipment are written for each method and are updated every two years or sooner if needed.
- The use of qualified personnel.
- Reliable and well maintained equipment.
- Appropriate calibrations and standards; including the use of traceable or certified reference materials.
- The implementation of a comprehensive, organized and straightforward documentation system.
- A program of "in house" training and proficiency of the analysts on analytical procedures, methods, and instrumentation. The documentation of training is maintained in individual training files.
- Appropriate reagents and supplies.
- The close supervision of all operations by the Agency Laboratory QA Officer, management and senior personnel.

5.2 Quality Control (QC) Program

QC consists of the techniques used to assess and ensure the quality of the analytical measurement process. Laboratory personnel routinely check the quality of analytical work through analysis of reference samples, duplicate samples, and spiked samples. Accuracy and precision are evaluated on each analytical batch and completeness may be evaluated for specific projects by the QA Officer. Statistically based control limits are established for each analytical method and matrix and are used to assess the quality of analytical results.

The Guam EPA laboratory uses the following QC assessment tools:

- Accuracy is evaluated through the use of spiked samples (matrix spikes and matrix spike duplicates, blank spikes and blank spike duplicates, and surrogate spikes) for each analytical batch or for each sample matrix, whichever is more

frequent. The spiked results are calculated and a percent recovery determination is calculated by the analyst. The percent recovery is compared to the appropriate statistically based control limits to assess method performance and the effect the sample matrix has on the analysis.

- The use of duplicate samples (sample duplicates, matrix spike duplicates and blank spike duplicates) enables the laboratory staff to assess the precision of the analytical batch. The relative percent difference (RPD) between the original sample and its duplicate is calculated by the analyst. The RPD is compared to the appropriate statistically based control limit to assess method reproducibility and the sample homogeneity.

In addition, the laboratory ensures all data meets the overall QA objectives with the following QC tools:

- The use of peer and/or supervisory review of all data inputs, calculations, and reports. A knowledgeable and well-trained analyst, supervisor or QA Officer reviews all data prior to release.

- The use of second source checks standards to ensure reliability of the primary source.

6.0 Data Management

Guam EPA is currently upgrading its data storage and data sharing capabilities. With the recent purchase of several computers and networking software, the agency will soon have a system that will greatly enhance water quality assessment efforts at a local level. By using a standard database platform (i.e. Microsoft Access in conjunction with a Laboratory Information Management System) users will be able to import, process and export data in a variety of formats with relative ease. The networked database along with an assortment of file transfer processes will provide extremely powerful data sharing capabilities at the local, regional and national levels.

Prior to input into the Laboratory Information Management System, the Laboratory QA/QC certifying officer evaluates all data with project data quality criteria and performance specifications. Data entry and access to information is restricted to authorized users (i.e. password protected) and two system administrators, who reside within the laboratory.

Data management and analysis procedures emphasize the use of STORET (STOrage and RETrieval), U.S. EPA's computerized data storage and retrieval system. Each data processing step is accompanied by a QA/QC check to assure the availability of an accurate database. All data are verified from original field sheets and data printouts. Corrections are made, checked and the procedure repeated until an error-free copy is obtained. All verified data is then forwarded to the USEPA R9 STORET representative, who will then upload it into STORET as soon as possible.

The Guam EPA database will also be used to regularly update information into the U.S. EPA Assessment Database and the STORET database to facilitate report generation for all federal reporting requirements. All databases are being incorporated into a Geographic Information System to visually display and analyze the data.

7.0 Data Analysis/Assessment

Data analysis and assessment methodology for determining attainment of water quality standards is described under section III.B. ***Assessment Methodology.*** For this reporting period, only data for the Recreational Beach Waters was sufficiently available.

8.0 Reporting

Guam produces water quality reports and lists called for under Sections 305(b), 303(d), 314, and 319 of the Clean Water Act and Section 406 of the Beaches Act.

9.0 Programmatic Evaluation

Guam EPA, in consultation with U.S. EPA Region 9, conducts periodic reviews of each aspect of its monitoring program to determine how well the program serves its water quality decision needs for all Guam waters, including all waterbody types. This involves evaluating the monitoring program to determine how well each of the elements is addressed and determining how needed changes and additions are incorporated into future monitoring cycles. U.S. EPA Region 9 representatives conduct program reviews twice annually; and teleconferencing is scheduled between Guam program managers/staff and federal representatives as necessary.

10.0 General Support and Infrastructure Planning

Budgetary, personnel, and logistical constraints limit the number and frequency of water-quality samples collected as part of a water-quality monitoring program. Laboratory chemical analyses are relatively expensive, and field personnel are not always able to collect data during critical conditions or events (for example, during extreme high- or low-flow conditions, spills, or during weekends and/or late-night hours). These constraints can limit the ability of environmental monitoring programs to document important water-quality conditions.

EMAS's current and future resource needs required to fully implement its monitoring program strategy include:

- **Funding:** The initial funding for EMAP was limited to one year. An alternate funding source must be identified to incorporate EMAP as a regular monitoring tool under the Comprehensive Monitoring Strategy (CMS). Needed funds will be used for off-island analytical services.
- **Personnel:** Additional personnel are required to effectively conduct the added monitoring tasks under the CMS. EMAS may reorganize its current staff in an effort to meet the mandates of the division; and in the meantime, efforts will be undertaken to recruit additional staff. The base pay of a level one biologist is about $31,000/year without benefits. EMAS is proposing that each monitoring program be implemented by one staff.

- **Training:** Training and professional development have always been a priority. As training plans become more formalized and strategic in nature, new emphasis will be placed on *minimum proficiencies* at recruitment, developing *program specific skills and knowledge*, *cross-training*, and specialized or *career enhancement training.*
- **Lab resources:** Possible relocation of the laboratory must be considered. Such action will severely impact the operations of the laboratory. EMAS will follow its five year workplan and prioritize core objectives to maximize use of resources.

11.0 Comprehensive Assessment Approach

A copy of Guam's CMS is attached as **Appendix E.**

B. Assessment Methodology

Guam surface and marine waters have multiple **"Designated Uses"** ranging from *aquatic life protection* (preservation, propagation, survival and maintenance), *primary* (whole body) *and secondary* (limited) *contact recreation,* and *drinking water use* (freshwater sources only). Assessment methodologies and specific designated-use criteria employed in determining a waterbody's "use-support status" are discussed in this section.

1.0 The Revised Water Classification System

Tables 9, 10, and 11 summarize the revised water classification system. All are associated "Designated Uses" and "Use Support" criteria. This information forms the basis of assessments, methodologies or the determination of the extent to which Guam waters achieve their uses.

2.0 Types of Assessment Information

"**Evaluated Waters**" are those for which the use support decision is based on information other than site-specific ambient data. These include data on land use, location of sources, and best professional judgment of qualified biologists. Any data over five years old are considered "evaluated data".

"Monitored Waters" are those for which the use support decision is principally based on current, site-specific, ambient monitoring data believed to accurately portray water quality conditions. Minimum data collection is quarterly.

3.0 Guidelines for Use Support Determination for Guam Waters

The Guam WQS, revised and adopted in 2002, lists *Enterococci* and *Eschericia coli* as its primary indicators for microbiological quality in marine and freshwater, respectively. Guam EPA has been using these indicators since 1995.

Guam EPA conducts weekly analysis of 42 marine recreational sites yearly **(See Figure 6, Appendix A and Table B4, Appendix B).** One freshwater site routinely added during the summer months is impaired and has been deactivated. Advisories are released

weekly based on instantaneous and geometric mean standards (from 1986 Ambient Water Quality Criteria for Bacteria).

Monitoring of bacteria (*E. coli*) levels in all other freshwater bathing areas (monitored under the Monitoring Program based on a rotating-basin approach) is not of sufficient frequency (<5 samples during a 30-day period) to apply geometric mean criteria as required by the RBMP. Therefore, freshwater microbiological data is not used for public health advisory releases; but this data is used to determine use-support for recreation if five sequential samples are collected. From these five (or more) data points, a geometric mean can be calculated.

Because of Guam's tropical environment, the recreational bathing season is considered year-round. In addition, recreational use even in sites designated for limited contact recreation may be high. Therefore, waters designated for limited contact recreation (S3 and M3 sites) utilize the "Moderate Full Body Contact Recreation" allowable densities from the 1986 criteria. Whole body contact recreation waters (S1, S2, M1, and M2) incorporate the "Designated Beach Area" assignments.

Table 9. Categories and Designated Uses Assigned to Guam Waters

Category	Quality	Description	Primary Designated Uses
M-1	Excellent	Marine Waters	whole body contact recreation, aquatic life, consumption
M-2	Good	Marine Waters	whole body contact recreation, aquatic life, consumption
M-3	Fair	Marine Waters	limited body contact recreation, aquatic life, consumption
S-1	High	Surface Water	whole body contact recreation, drinking water, aquatic life, consumption
S-2	Medium	Surface Water	whole body contact recreation, drinking water (with treatment), aquatic life, consumption
S-3	Low	Surface Water	limited body contact, aquatic life, consumption
G-1	Resource	Groundwater	drinking water
G-2	Recharge	Groundwater	recharge to G-1

Table 10. Selected Numeric Criteria for Priority Toxic Pollutants

Compound	AQUATIC LIFE				HUMAN HEALTH	
	Freshwater (µg/l)		Saltwater (µg/l)		Consumption (µg/l)	
	Acute	Chronic	Acute	Chronic		
	(B1)	(B2)	(C1)	(C2)	(D1*)	(D2*)
Copper	18	12	4.8	3.1	1300	X
Mercury	2.4	0.012	2.1	0.025	0.050	0.051
Cyanide	22	5.2	X	X	700	200,000
Benzene	X	X	X	X	1.2	71
Thallium	X	X	X	X	1.7	6.3

*D1 = Assumes exposure due to consumption of (fresh) water plus organisms living in the water
*D2 = Assumes exposure due to consumption of organisms only (e.g. marine water organisms)
X = No assigned Value

Table 11. Numeric Criteria Applied to Categories of Water

Water Categories	Numeric Criteria*
M–1	C1, C2, D2
M-2	C1, C2, D2
M-3	C1, C2, D2
S-1	B1, B2, D1
S-2	B1, B2, D1
S-3	B1, B2, D2
G-1	Refer to the Guam Water Quality Standards
G-2	Refer to the Guam Water Quality Standards

***(Refers to columns provided in Table 10)**

3.1 Whole Body Contact Recreation

Microbiological criteria, used to determine use support for waters designated for whole body contact recreation (S1, M1, S2 and M2), are depicted in **Table 12**. Criteria are consistent with recommendations from 1997 EPA guidance.

3.2 Limited Contact Recreation

Bacterial criteria used to determine use support for waters designated for limited (secondary) contact recreation use (S3 and M3) are depicted in **Table 13**. These criteria are consistent with recommendations from 1997 EPA guidance.

4.0 Aquatic Life Use Support (ALUS)

Four data types are used for ALUS determination: habitat, toxicological, physical/chemical, and biological. Guam EPA generally conducts the physical/chemical methods (conventional) and toxicological methods during the effective reporting period. Habitat data and bioassessment data are generated by the DAWR, Department of Agriculture. Guam EPA collaborates with DAWR so that available habitat and bioassessment data is incorporated in the Agency's assessment and monitoring reports. Guam Waterworks Authority (GWA) also conducts limited toxicant methods (priority pollutants and metals) and limited conventional methods. Available data may similarly be incorporated in the Agency's assessment and monitoring reports. These data are of varying data quality levels; the Hierarchy of physical/chemical Data Levels for Evaluation of Aquatic Life Use Attainment (1997 305(b) EPA guidance) will be used to determine ALUS. The guideline for determining ALUS using more than one type of data is shown in **Table 14.**

5.0 Physical/Chemical Methods

As previously stated, the assessment for Aquatic Life Use Support is based on physical/chemical data collected for fresh and marine water samples. Both conventional and toxicant data are analyzed by Guam EPA. Guam EPA has collected extensive physical and chemical data at sites established during the early 1980s and utilizes this collected data as ambient characteristics.

Analytical parameters evaluated by Guam EPA are listed in **Table C5 in Appendix C.** All of Guam EPA Physical/Chemical data is considered "moderate/high quality", based on technical components and spatial/temporal coverage, as defined by USEPA guidance documents.

EPA guidance (Sept. 1997) states the importance of incorporating the established criteria for conventionals and toxicants in ALUS determinations and to use the "worst case" approach where multiple parameters are available (EPA, 1997). **Table 15 and Table 16** describe the decision guidelines used for determining ALUS using Physical/Chemical Methods (conventionals data and toxicant data). The Guam WQS provide standards for these conventionals which are presented in **Table C6 in Appendix C**.

6.0 Habitat Assessment

Limited habitat assessment data has been submitted by the Government of Guam Department of Agriculture, Division of Aquatic and Wildlife Resources. Data are categorized as either level 1 data quality (unknown or low precision and sensitivity) or level 2 (low precision and sensitivity).

Federal guidelines for ALUS determination using habitat assessment data are provided in **Table 17.**

7.0 Bioassessment

Limited bioassessment data has been submitted by the Government of Guam Department of Agriculture, Division of Aquatic and Wildlife Resources (DAWR). Bioassessment data are categorized as being level 1 through level 4 data quality, depending on the waterbody assessed.

Federal guidelines for ALUS determination using bioassessment data are provided in **Table 18.**

8.0 DAWR River Classification Procedures

Local freshwater literature was researched for information on native and introduced species, level of development, and status of habitat. Rivers were also inspected from the road on a drive-by survey. And finally, data from river surveys performed by DAWR staff were reviewed.

A river was considered *fully supporting* ***biologically*** if no introduced species were reported from that river; *partially supporting biologically* if there were more native species than introduced or if only estuarine species were seen; and *not supporting biologically* if there were more introduced species than native.

Regarding **habitat assessment** data, a river was considered *fully supporting* if minimal human impacts were evident; *partially supporting* if some development had occurred; and *not supporting* if the river was heavily impacted (i.e. channelized and/or adjacent to heavily developed areas).

Regarding the classification of ***level of information for bioassessment***, *level 3 and 4* were reserved for rivers where extensive surveys have been conducted; *level 2* was given to ***rivers if information was available from the local literature;*** and *level 1* was used for ***rivers assessed during the drive-by survey or by anecdotal information***. For habitat assessment, only levels 1 and 2 were used because no SOPs are currently in place. Level 2 was used in cases where rivers were extensively surveyed and level 1 was used for rivers assessed in the drive-by survey. In cases where no data were available, no assessment was made and no level of information specified.

Table 12. Whole Body Contact Recreation Use Support

Level of Use Support	Criteria	
	Marine Water M1 and M2	**Fresh Water S1 and S2**
Fully Supporting	***Enterococci*: A geometric mean of 35 enterococci per 100mL (based on 5 sequential samples) is not exceeded AND the single sample density does not exceed 104 enterococci per 100mL.** ***Fecal coliform*: The single sample density does not exceed 200 cfu/100mL AND an arithmetic mean of effluent samples taken during 30-consecutive days does not exceed 200 cfu/100mL AND an arithmetic mean of effluent samples taken during 7-consecutive days does not exceed 400 cfu/100mL.**	***Escherichia coli*: A geometric mean of 126 e. coli per 100mL (based on 5 samples taken sequentially) is not exceeded AND the single sample density does not exceed 235 e. coli per 100mL.** ***Enterococci*: A geometric mean of 33 enterococci/100mL (based on 5 sequential samples) is not exceeded AND the single sample density does not exceed 61 enterococci per 100mL.** ***Fecal coliform*: The single sample density does not exceed 200 cfu/100mL AND** **An arithmetic mean of effluent samples taken during 30-consecutive days does not exceed 200 cfu/100mL AND an arithmetic mean of effluent samples taken during 7-consecutive days does not exceed 400 cfu/100mL**
Partially Supporting	***Enterococci*: Geometric mean of 35 enterococci per 100mL (based on 5 sequential samples) is met AND the single-sample criterion of 104 enterococci per 100mL is exceeded during the year.** ***Fecal coliform*: The single sample density of 200 cfu/100mL is exceeded during the year AND the arithmetic mean of effluent samples taken during 30-days consecutive does not exceed 200 cfu/100mL during the year AND an arithmetic mean of effluent samples taken during 7-days consecutive does not exceed 400 cfu/100mL during the year.**	***Escherichia coli*: Geometric mean of 126 e. coli per 100mL (based on 5 sequential samples) is met AND single-sample criterion of 235 enterococci per100mL is exceeded during the year.** ***Enterococci*: A geometric mean of 33 enterococci/100mL (based on 5 sequential samples) is met during the year AND the single-sample density of 61 enterococci per 100mL is exceeded during the year.** ***Fecal coliform*: The single sample density of 200 cfu/100mL is exceeded during the year AND the arithmetic mean of effluent samples taken during 30-days consecutive does not exceed 200 cfu/100mL during the year AND the arithmetic mean of effluent samples taken during 7-days consecutive does not exceed 400 cfu/100mL during the year.**
Not Supporting	***Enterococci*: Geometric mean standard of 35 enterococci per 100mL is not met.** ***Fecal coliform*: Arithmetic mean standard of 200 cfu per 100mL from 30-consecutive days is not met during the year AND the arithmetic mean standard of 400 cfu per 100mL from 7 consecutive days is not met during the year**	***Escherichia coli*: Geometric mean standard of 126 e.coli per 100mL is not met.** ***Enterococci*: Geometric mean standard of 35 enterococci per 100mL is not met.** ***Fecal coliform*: Arithmetic mean standard of 200 cfu per 100mL from 30-consecutive days is not met during the year AND arithmetic mean standard of 400 cfu per 100mL from 7 consecutive days is not met during the year.**

Table 13. Criteria for Limited Contact Recreation Use at Bathing Areas

Degree of Recreation Use Support	Criteria	
	Marine Water M3	**Fresh Water S3**
Fully Supporting	***Enterococci*: A geometric mean of 35 enterococci per 100mL (based on 5 sequential samples) is not exceeded AND the single sample density does not exceed 124 enterococci per 100mL.** ***Fecal coliform*: The single sample density does not exceed 200 cfu/100mL AND An arithmetic mean of effluent samples taken during 30-consecutive days does not exceed 200 cfu/100mL AND an arithmetic mean of effluent samples taken during 7-consecutive days does not exceed 400 cfu/100mL.**	***Escherichia coli*: A geometric mean of 126 e. coli per 100mL (based on 5 samples taken sequentially) is not exceeded AND the single sample density does not exceed 298 e. coli per 100mL.** ***Enterococci*: A geometric mean of 33 enterococci/100mL (based on 5 sequential samples) is not exceeded AND the single sample density does not exceed 89 enterococci per 100mL.** ***Fecal coliform*: The single sample density does not exceed 200 cfu/100mL AND** **An arithmetic mean of effluent samples taken during 30-consecutive days does not exceed 200 cfu/100mL AND an arithmetic mean of effluent samples taken during 7-consecutive days does not exceed 400 cfu/100mL.**
Partially Supporting	***Enterococci*: Geometric mean of 35 enterococci per 100mL (based on 5 sequential samples) is met AND the single-sample criterion of 124 enterococci per 100mL is exceeded during the year.** ***Fecal coliform*: The single sample density of 200 cfu/100mL is exceeded during the year AND the arithmetic mean of effluent samples taken during 30-days consecutive does not exceed 200 cfu/100mL during the year AND an arithmetic mean of effluent samples taken during 7-days consecutive does not exceed 400 cfu/100mL during the year.**	***Escherichia coli*: Geometric mean of 126 e. coli per 100mL (based on 5 sequential samples) is met AND single-sample criterion of 298 enterococci per 100mL is exceeded during the year.** ***Enterococci*: A geometric mean of 33 enterococci/100mL (based on 5 sequential samples) is met during the year AND the single-sample density of 89 enterococci per 100mL is exceeded during the year.** ***Fecal coliform*: The single sample density of 200 cfu/100mL is exceeded during the year AND the arithmetic mean of effluent samples taken during 30-days consecutive does not exceed 200 cfu/100mL during the year AND the arithmetic mean of effluent samples taken during 7-days consecutive does not exceed 400 cfu/100mL during the year.**
Not Supporting	***Enterococci*: Geometric mean standard of 35 enterococci per 100mL is not met.** ***Fecal coliform*: Arithmetic mean standard of 200 cfu per 100mL from 30-consecutive days is not met during the year AND the arithmetic mean standard of 400 cfu per 100mL from 7 consecutive days is not met during the year.**	***Escherichia coli*: Geometric mean standard of 126 e.coli per 100mL is not met.** ***Enterococci*: Geometric mean standard of 35 enterococci per 100mL is not met.** ***Fecal coliform*: Arithmetic mean standard of 200 cfu per 100mL from 30-consecutive days is not met during the year AND arithmetic mean standard of 400 cfu per 100mL from 7 consecutive days is not met during the year.**

Table 14. Determination of ALUS Using More Than One Data Type

ALUS Attainment	
Fully Supporting:	**No impairment indicated by all data types.**
Fully Supporting but Threatened:	**No impairment indicated by all data types; one or more categories indicate an apparent decline in ecological quality over time or potential water quality problems requiring additional data or verification or other information suggest a threatened determination.**
ALUS Non-Attainment	
***Partially Supporting:**	**Impairment indicated by one or more data types and no impairment indicated by others.**
***Not Supporting:**	**Impairment indicated by all data types.**
***A determination of *Partially Supporting* or *Not Supporting* could be made based on the nature and rigor of the data and site-specific conditions in the results of the data types. If bioassessment (usually Level 3 or 4) indicates impairment, then a determination of *Not Supporting* should be made.**	

Table 15. Decision Guidelines for Conventionals Used to Assess ALUS in Freshwater Rivers and in Marine Waters

Degree of Aquatic Life Use Support	Criteria
Fully Supporting	**For any one pollutant, GUAM WQS exceeded in ≤ 10 percent of measurements.**
Partially Supporting	**For any one pollutant, GUAM WQS exceeded in 11 to 25 percent of measurements.**
Not Supporting	**For any one pollutant, GUAM WQS exceeded in > 25 percent of measurements.**

9.0 Human Health Consumption

Waters designated for aquatic life on Guam and elsewhere in the United States, are also designated as protected for human consumption based on the premise that where there is aquatic life there is likely to be human consumption as well. For fresh waters that are designated for drinking water (S1), human consumption criteria **(Table 10, Column D1)** are calculated based on the possibility of people being exposed to contaminants by drinking the water and from eating aquatic organisms that have been living in the same water. For fresh waters not designated for drinking water (S2 and S3), and for marine waters, human consumption is based on the possibility of people eating aquatic organisms, only.

10.0 Drinking Water

The Ugum River and Fena Reservoir are the island's only supply of surface drinking water. Guam EPA utilized the guidance provided in the federal 305(b) guidelines to make its use determinations, which recommend tapping a variety of information types to reach conclusions. Guam EPA's best data are provided by monitoring undertaken to meet requirements of the SDWA and information related to use restrictions including:

- Closures of source waters that are used for drinking water supply;
- Contamination-based drinking water supply advisories lasting more than 30 days per year;
- Turbidity of raw water from the river is extremely high during rainy seasons that even the existing conventional treatment system cannot process finish water meeting the SDWA Standards without pre-sedimentation basins.
- Public water suppliers requiring increased monitoring due to the inability of the Ugum Water Treatment Plant to treat water from the river meeting the turbidity standards.
- Failure to achieve the removal and/or inactivation of Giardia and viruses via treatment techniques consisting of sedimentation, filtration and disinfection that require a massive protection of source water from human or animal activity that contribute disease causing organisms in the source water.

The Assessment Framework on **Table 19** was cited from the federal guidelines and illustrates the classification, monitoring data, and use support restrictions evaluated to make use support decisions.

Table 16. Decision Guidelines for Toxicants Used to Assess ALUS in Freshwater Rivers and in Marine Waters

Degree of Aquatic Life Use Support	Criteria
Fully Supporting	**For any one pollutant, no more than 1 exceedance of acute criteria within a 3-year period based on grab or composite samples and no more than 1 exceedance of chronic criteria within a 3-year period based on grab or composite samples**
Partially Supporting	**For any one pollutant, acute or chronic criteria exceeded more than once within a 3-year period, but in ≤ 10 percent of samples.**
Not Supporting	**For any one pollutant, acute or chronic criteria exceeded in >10 percent of samples.**

Table 17. ALUS Determination Based on Habitat Assessment Data

Degree of Aquatic Life Use Support	Criteria
Fully Supporting	**Reliable data indicate natural channel morphology, substrate composition, bank/riparian structure, and flow regime of region. Riparian vegetation of natural types and of relatively full standing crop biomass (i.e., minimal grazing or destructive pressure).**
Partially Supporting	**Modification of habitat slight to moderate usually due to road crossings, limited riparian zones because of encroaching land-use patterns, and some watershed erosion. Channel modification slight to moderate.**
Not Supporting	**Moderate to severe habitat alteration by channelization and dredging activities, removal of riparian vegetation, bank failure, heavy watershed erosion or alteration of flow regime.**

Table 18. ALUS Determination Based on Bioassessment Data

Degree of Aquatic Life Use Support	Criteria
Fully Supporting	**Reliable data indicate functioning, sustainable biological assemblages (e.g. fish, macro invertebrates, or algae) none of which has been modified significantly beyond the natural range of the reference condition.**
Partially Supporting	**At least one assemblage (e.g. fish, macro invertebrates, or algae) indicates moderate modification of the biological community compared to the reference condition.**
Not Supporting	**At least one assemblage indicates nonsupport. Data clearly indicate severe modification of the biological community compared to the reference condition.**

Table 19. Assessment Framework for Determining Degree of Drinking Water Use Support

Classification	Monitoring Data		Use Support Restrictions
Full Support	**Contaminants do not exceed water quality criteria**	**and/or**	**Drinking water use restrictions are not in effect.**
Full Support but Threatened	**Contaminants are detected but do not exceed water quality criteria**	**and/or**	**Some drinking water use restrictions have occurred and/or the potential for adverse impacts to source water quality exists.**
Partial Support	**Contaminants exceed water quality criteria intermittently**	**and/or**	**Drinking water use restrictions resulted in the need for alternative treatment techniques with associated increases in cost.**
Nonsupport	**Contaminants exceed water quality criteria constantly**	**and/or**	**Drinking water use restrictions resulted in closures.**
Unassessed	**Source water quality has not been assessed for contaminants used or potentially present.**		

C. Assessment Results

This section provides: (1) the results of Guam's surface water assessments, including the categorization of surface water segments based on designated use support data, (2) probability-based survey results, and (3) Guam's list of impaired and threatened waters in accordance with Section 303(d) of the CWA.

1.0 Five –Part Categorization of Surface Waters

The five (5) Reporting Category types for surface water are:

Category 1: All designated uses are supported, no use is threatened;

Category 2: Available data and/or information indicate that some, but not all of the designated uses are supported;

Category 3: There is insufficient available data and/or information to make a use support determination;

Category 4: Available data and/or information indicate that at least one designated use is not being supported or threatened, but a TMDL is not needed;

Category 4a: A TMDL to address a specific segment/pollutant combination has been approved or established by EPA;

Category 4b: A use impairment caused by a pollutant is being addressed by the state through other pollution control requirements;

Category 4c: A use is impaired, but the impairment is not caused by a pollutant; and

Category 5: Available data and/or information indicate that at least one designated use is not being supported or is threatened, and a TMDL is needed.

1.1 Guam Rivers/Streams – Table 20

Table 20 provides the following information about the one hundred one (101) island rivers/streams assessment units for which Guam EPA monitors water quality under the Status and Trends Monitoring Program.

* Water name
* Location (watershed location)
* Water status (i.e. impaired, not assessed)
* Surface water reporting category (see Section 1.0 above)
* Assessment Unit ID
* Water Size /Unit

Eighty-nine (89) river/stream assessment units totaling 206.73 miles were not monitored and are thus reported under Category 3.

Five (5) Ugum River assessment units totaling 21.58 miles are impaired, however, because a TMDL has been developed, these river units are reported under Category 4a.[2]

The following seven (7) river/stream assessment units are reported under Category 5 (impaired) and remain on the 303(d) list:

Lonfit River segment	GUPGRL-1-51B	3.79 miles
Lonfit River segment	GUPGRL-2	1.07 miles
Agana Swamp[3]	GUG1-B	6.40 acres
Hagatna River	GUAGRA-3	0.52 miles
Landfill Leachate Stream	GUPGRL-0	0.05 miles
Pago River segment	GUPGRP-1	0.10 miles
Pago River segment	GUPGRP-2	4.73 miles

Table B12., Appendix B provides the base information Guam EPA used to create Table 20. One hundred ninety-five (195) rivers/tributaries are identified according to their assigned Guam River Identification Numbers (UOG Marine Lab Technical Report 75)[4]

The following information is also provided for each river/tributary:[5] ***Channel length*** (in miles); ***Receiving Water*** (location into which river/tributary waters flow); ***Segment ID***

2 *The Ugum River was delisted last reporting period. An approved Sediment TMDL is pending implementation.*

3 See under this Part III: § F. Consumption Concerns, § 3.2.2. Agana Swamp

4 Best, B.R. & C.E. Davidson. 1981. Inventory and Atlas of the Inland Aquatic Ecosystems of the Marianas Archipelago. 226 pages.

Table 20. 2008 Assessment Data for Rivers - Streams

Water Name	Assessment Unit ID	Location	State	Water Type	Water Size	Unit	Water Status	Reporting Category
(open storm drain discharge to E. Hagatna Bay)	GUAGRD	WATERSHED: Northern	GU	RIVER	0.15	MILES	NOT ASSESSED	3
Achang River 1	GUMZRAC-2	WATERSHED: Manell	GU	RIVER	0.5	MILES	NOT ASSESSED	3
Achang River 2	GUMZRAC	WATERSHED: Manell	GU	RIVER	0.3	MILES	NOT ASSESSED	3
Agaga River	GUULRAG	WATERSHED: Cetti	GU	RIVER	0.72	MILES	NOT ASSESSED	3
Agana Swamp	GUG-1B	WATERSHED: Agana	GU	WETLAND	6.4	ACRES	IMPAIRED	5
Aguada River	GUAPRAG	WATERSHED: Apra	GU	RIVER	1.95	MILES	NOT ASSESSED	3
Ajayan River	GUMZRAJ	WATERSHED: Manell	GU	RIVER	3.86	MILES	NOT ASSESSED	3
Almagosa Spring	GUFLRA-1	WATERSHED: Talofofo	GU	RIVER	0.09	MILES	NOT ASSESSED	3
Asalonso River/unnamed tributary	GUINRAS	WATERSHED: Asalonso	GU	RIVER	2.1	MILES	NOT ASSESSED	3
Asan River 1	GUASRI-3	WATERSHED: Piti/Asan	GU	RIVER	1.32	MILES	NOT ASSESSED	3
Asan River 2	GUASRI-4	WATERSHED: Piti/Asan	GU	RIVER	0.71	MILES	NOT ASSESSED	3
Aslinget River 1	GUINRAL-1	WATERSHED: Dandan	GU	RIVER	1.23	MILES	NOT ASSESSED	3
Aslinget River 2	GUINRAL-2	WATERSHED: Dandan	GU	RIVER	1.33	MILES	NOT ASSESSED	3
Asmafines River	GUULRAS	WATERSHED: Cetti	GU	RIVER	0.78	MILES	NOT ASSESSED	3
Atantano River 1	GUAPRA-2	WATERSHED: Apra	GU	RIVER	3.3	MILES	NOT ASSESSED	3
Atantano River 2	GUAPEA	WATERSHED: Apra	GU	RIVER	6.23	MILES	NOT ASSESSED	3
Big Guatali River	GUAPRA-1	WATERSHED: Apra	GU	RIVER	2.15	MILES	NOT ASSESSED	3
Bonya River	GUMLRB	WATERSHED: Talofofo	GU	RIVER	1.79	MILES	NOT ASSESSED	3
Cetti River	GUULRCL	WATERSHED: Cetti	GU	RIVER	1.89	MILES	NOT ASSESSED	3
Chagame River/ La Sa Fua River	GUULRL-1	WATERSHED: Umatac	GU	RIVER	2.46	MILES	NOT ASSESSED	3
Chaligan Creek 1	GUATRC-2	WATERSHED: Taelayag	GU	RIVER	0.91	MILES	NOT ASSESSED	3
Chaligan Creek 2	GUATRC	WATERSHED: Taelayag	GU	RIVER	0.06	MILES	NOT ASSESSED	3

Table 20. 2008 Assessment Data for Rivers - Streams

Water Name	Assessment Unit ID	Location	State	Water Type	Water Size	Unit	Water Status	Reporting Category
Finile Creek	GUATRF	WATERSHED: Agat	GU	RIVER	0.36	MILES	NOT ASSESSED	3
Fonte River 1	GUAGRF-2	WATERSHED: Fonte	GU	RIVER	1.16	MILES	NOT ASSESSED	3
Fonte River 2	GUAGRF-1	WATERSHED: Fonte	GU	RIVER	1.93	MILES	NOT ASSESSED	3
Gaan River 1	GUATRG-2	WATERSHED: Agat	GU	RIVER	0.55	MILES	NOT ASSESSED	3
Gaan River 2	GUATRG	WATERSHED: Agat	GU	RIVER	0.62	MILES	NOT ASSESSED	3
Geus River 1	GUMZRG-1	WATERSHED: Geus	GU	RIVER	0.96	MILES	NOT ASSESSED	3
Geus River 2	GUMZRG	WATERSHED: Geus	GU	RIVER	0.5	MILES	NOT ASSESSED	3
Geus River 3	GUMZRG-2	WATERSHED: Geus	GU	RIVER	0.76	MILES	NOT ASSESSED	3
Hagatna River	GUAGRA-3	WATERSHED: Agana	GU	RIVER	0.52	MILES	IMPAIRED	5
Hagatna River & Chaot River	GUAGRA-2	WATERSHED: Agana	GU	RIVER	2.9	MILES	NOT ASSESSED	3
Hagatna Springs	GUAGRA-1	WATERSHED: Agana	GU	RIVER	0.04	MILES	NOT ASSESSED	3
Imong River 1	GUFLRI-2	WATERSHED: Talofofo	GU	RIVER	2.54	MILES	NOT ASSESSED	3
Imong River 2	GUFLRI-1	WATERSHED: Talofofo	GU	RIVER	1.83	MILES	NOT ASSESSED	3
Inarajan River 1	GUINRI-1	WATERSHED: Inarajan	GU	RIVER	8.64	MILES	NOT ASSESSED	3
Inarajan River 2	GUINRI-2	WATERSHED: Inarajan	GU	RIVER	0.86	MILES	NOT ASSESSED	3
La Sa Fua River	GUULRL-2	WATERSHED: Umatac	GU	RIVER	2.02	MILES	NOT ASSESSED	3
Laelae River	GUULRU-1	WATERSHED: Umatac	GU	RIVER	1.94	MILES	NOT ASSESSED	3
Laguas River	GUAPRL	WATERSHED: Apra	GU	RIVER	0.81	MILES	NOT ASSESSED	3
Landfill Leachate Stream	GUPGRL-0	WATERSHED: Pago	GU	RIVER	0.05	MILES	IMPAIRED	5
Laolao River	GUINRL	WATERSHED: Inarajan	GU	RIVER	4.25	MILES	NOT ASSESSED	3
Liyog River	GUMZRL	WATERSHED: Maneli	GU	RIVER	1.81	MILES	NOT ASSESSED	3
Lonfit River 1	GUPGRL-1-51E-51F-51-G	WATERSHED: Pago	GU	RIVER	3.07	MILES	NOT ASSESSED	3
Lonfit River 2	GUPGRL-2	WATERSHED: Pago	GU	RIVER	1.07	MILES	IMPAIRED	5

Table 20. 2008 Assessment Data for Rivers - Streams

Water Name	Assessment Unit ID	Location	State	Water Type	Water Size	Unit	Water Status	Reporting Category
Lonfit River 3	GUPGRL-1-51B	WATERSHED: Pago	GU	RIVER	3.79	MILES	IMPAIRED	5
Maagas River	GUTURM-1	WATERSHED: Talofofo	GU	RIVER	0.39	MILES	NOT ASSESSED	3
Madofan River	GUULRMF	WATERSHED: Cetti	GU	RIVER	0.73	MILES	NOT ASSESSED	3
Madog River	GUULRM	WATERSHED: Umatac	GU	RIVER	2.11	MILES	NOT ASSESSED	3
Mahlac River	GUTURMA-1	WATERSHED: Talofofo	GU	RIVER	4.86	MILES	NOT ASSESSED	3
Manell River	GUMZRML	WATERSHED: Manell	GU	RIVER	2.65	MILES	NOT ASSESSED	3
Masso River 1	GUAPRM-1B	WATERSHED: Piti/Asan	GU	RIVER	0.31	MILES	NOT ASSESSED	3
Masso River 2	GUAPRM-1A	WATERSHED: Piti/Asan	GU	RIVER	2.58	MILES	NOT ASSESSED	3
Matague River	GUASRM	WATERSHED: Piti/Asan	GU	RIVER	1.2	MILES	NOT ASSESSED	3
Maulap River 1	GUFLRM-1	WATERSHED: Talofofo	GU	RIVER	0.44	MILES	NOT ASSESSED	3
Maulap River 2	GUFLRM-2	WATERSHED: Talofofo	GU	RIVER	2.41	MILES	NOT ASSESSED	3
Namo River 1	GUATRN-1A	WATERSHED: Agat	GU	RIVER	2.44	MILES	NOT ASSESSED	3
Namo River 2	GUATRN-2	WATERSHED: Agat	GU	RIVER	0.36	MILES	NOT ASSESSED	3
Namo River/ unnamed tributary	GUATRN-1	WATERSHED: Agat	GU	RIVER	0.11	MILES	NOT ASSESSED	3
Pagachao Creek	GUATRT-1	WATERSHED: Taelayag	GU	RIVER	0.97	MILES	NOT ASSESSED	3
Pago River 1	GUPGRP-1	WATERSHED: Pago	GU	RIVER	0.1	MILES	IMPAIRED	5
Pago River 2	GUPGRP-2	WATERSHED: Pago	GU	RIVER	4.73	MILES	IMPAIRED	5
Pauliluc River	GUINRAP	WATERSHED: Dandan	GU	RIVER	4.55	MILES	NOT ASSESSED	3
Pigua River 1	GUMZRP	WATERSHED: Toguan	GU	RIVER	0.13	MILES	NOT ASSESSED	3
Pigua River 2	GUMZRP-2	WATERSHED: Toguan	GU	RIVER	1.5	MILES	NOT ASSESSED	3
Sadog Gago River	GUFLRSG-1	WATERSHED: Talofofo	GU	RIVER	0.52	MILES	NOT ASSESSED	3
Sagua River	GUATRSG	WATERSHED: Taelayag	GU	RIVER	0.53	MILES	NOT ASSESSED	3
Salinas River	GUATRS	WATERSHED: Agat	GU	RIVER	0.47	MILES	NOT ASSESSED	3

Table 20. 2008 Assessment Data for Rivers - Streams

Water Name	Assessment Unit ID	Location	State	Water Type	Water Size	Unit	Water Status	Reporting Category
Sarasa River	GUTURS-1	WATERSHED: Talofofo	GU	RIVER	0.05	MILES	NOT ASSESSED	3
Sasa River 1	GUAPRS-1	WATERSHED: Apra	GU	RIVER	0.85	MILES	NOT ASSESSED	3
Sasa River 2	GUAPRS-2	WATERSHED: Apra	GU	RIVER	1.15	MILES	NOT ASSESSED	3
Sella River	GUULRS	WATERSHED: Cetti	GU	RIVER	2.49	MILES	NOT ASSESSED	3
Sigua River	GUPGRS	WATERSHED: Pago	GU	RIVER	6.13	MILES	NOT ASSESSED	3
Sumay River	GUMZRSY	WATERSHED: Manell	GU	RIVER	1.02	MILES	NOT ASSESSED	3
Taelayag Creek	GUATRTA	WATERSHED: Taelayag	GU	RIVER	1.34	MILES	NOT ASSESSED	3
Taleyfac River	GUATRT-2	WATERSHED: Taelayag	GU	RIVER	3.79	MILES	NOT ASSESSED	3
Talofofo River 1	GUTURT-2	WATERSHED: Talofofo	GU	RIVER	13.61	MILES	NOT ASSESSED	3
Talofofo River 2	GUTUETO	WATERSHED: Talofofo	GU	RIVER	0.46	MILES	NOT ASSESSED	3
Talofofo River 3	GUTUETU	WATERSHED: Talofofo	GU	RIVER	0.96	MILES	NOT ASSESSED	3
Togcha River 1	GUTURTG-C	WATERSHED: Togcha	GU	RIVER	0.91	MILES	NOT ASSESSED	3
Togcha River 2	GUTURTG-1A	WATERSHED: Togcha	GU	RIVER	0.93	MILES	NOT ASSESSED	3
Togcha River 3	GUTURTG-2	WATERSHED: Togcha	GU	RIVER	0.05	MILES	NOT ASSESSED	3
Togcha River 4	GUTURTG-X	WATERSHED: Togcha	GU	RIVER	0.03	MILES	NOT ASSESSED	3
Togcha River 5	GUTURTG-1C	WATERSHED: Togcha	GU	RIVER	0.46	MILES	NOT ASSESSED	3
Togcha River (Agat)	GUATRTO	WATERSHED: Agat	GU	RIVER	0.87	MILES	NOT ASSESSED	3
Toguan River 1	GUMZRT-2	WATERSHED: Toguan	GU	RIVER	0.19	MILES	NOT ASSESSED	3
Toguan River 2	GUMZRT-1	WATERSHED: Toguan	GU	RIVER	1.19	MILES	NOT ASSESSED	3
Ugum River 1	GUTURU2	WATERSHED: Ugum	GU	RIVER	1.05	MILES	IMPAIRED	4a
Ugum River 2	GUTURU-1A	WATERSHED: Ugum	GU	RIVER	17	MILES	IMPAIRED	4a
Ugum River 3	GUTURU-1B	WATERSHED: Ugum	GU	RIVER	0.18	MILES	IMPAIRED	4a
Ugum River 4	GUTUETU-48H	WATERSHED: Talofofo	GU	RIVER	0.39	MILES	IMPAIRED	4a

Table 20. 2008 Assessment Data for Rivers - Streams

Water Name	Assessment Unit ID	Location	State	Water Type	Water Size	Unit	Water Status	Reporting Category
Ugum River 5	GUTURU-1C	WATERSHED: Ugum	GU	RIVER	2.96	MILES	IMPAIRED	4a
Umatac River	GUULRU-2	WATERSHED: Umatac	GU	RIVER	0.74	MILES	NOT ASSESSED	3
Unnamed Creek 1	GUASRI-2	WATERSHED: Piti/Asan	GU	RIVER	0.06	MILES	NOT ASSESSED	3
Ylig River 1	GUYNRY-1	WATERSHED: Ylig	GU	RIVER	23.47	MILES	NOT ASSESSED	3
Ylig River 2	GUYNRY-2	WATERSHED: Ylig	GU	RIVER	3.33	MILES	NOT ASSESSED	3
Ylig River 3	GUYNRY-3	WATERSHED: Ylig	GU	RIVER	0.41	MILES	NOT ASSESSED	3
Unnamed Creek 2	GUASRI-1	WATERSHED: Piti/Asan	GU	RIVER	0.16	MILES	NOT ASSESSED	3
Unnamed River 1	GUULRCR	WATERSHED: Cetti	GU	RIVER	0.3	MILES	NOT ASSESSED	3
Unnamed River 2	GUINRAGB	WATERSHED: Inarajan	GU	RIVER	0.72	MILES	NOT ASSESSED	3
Unnamed Tributary	GUFLRA-2	WATERSHED: Talofofo	GU	RIVER	2.18	MILES	NOT ASSESSED	3

(designated monitoring stations); ***GEPA GIS ID; Status*** (Rotating or Core as defined below); ***Watershed; Guam Water Quality Category (GWQC); Reporting Category*** (Category 1-5 as defined in Section 1.0; ***Size*** (i.e. miles) ***of Segment Assessed***.

The Table B12. river/tributary names are organized by watershed location. Each segment (monitoring station) is assigned a "Rotating" or "Core" status. Twenty-seven (27) ***"core" stations*** *will be monitored on an annual basis rather than on a rotating basin schedule to continue historical data collection (on these stations) dating back to 1987. The remaining* ***"rotating" stations*** *will be monitored in the scheduled sampling year assigned to the corresponding resource unit (watershed). Refer to* ***Table 9*** *for clarification about Guam Surface Water Classifications as S1, S2, S3 and respective designated uses assigned to those waters.*

The following categories of Causes/Stressors contributed to the impairment of Guam's Rivers/Streams: PCBs, pathogen indicators, leachate, dissolved oxygen, turbidity, and nitrate

Table B6a in Appendix B shows the applicable Source Categories (i.e. Industrial Point Sources, Combined Sewer Overflows, Agriculture, etc.) which contribute to the impairment of Guam's Rivers/Streams. There is no data available to determine the size of waters impaired by these various Source Categories for this reporting period.

1.2 Near Coastal and Marine Waters

Two waterbody types fall under this heading: Coastal/Recreational Waters and Marine Bays.

1.2.1 *Coastal and Recreational Waters – Table 21*

Guam Coastal/Recreational waters were assessed only for the Goal: "Protect and Enhance Public Health" and the Use: "Primary Contact/Swimming and Secondary Contact". All other Goal and Use categories were considered "Not Applicable".

Appendix B, Table B11. provides the 2008 Individual Use Support Summaries for Coastal/Recreational Waters. All beach waters are categorized based on 2007 Use Support Status. 113 beaches are identified and measure a total length of 43.65 shoreline miles. The size of each beach is provided (See "Water Size").

In 2006 and 2007, forty-two (42) active beach stations were monitored. "Active" beaches are Guam's Tier 1 Beaches as discussed on page 8, Part III. The "inactive" beaches are Guam's "Tier II or III" beaches and are under Reporting Category 3 in this table. One (1) Tier 1 Beach Station, Family Beach (N-19) was monitored and found to be fully supporting its designated use; however Guam EPA opted to leave N-19 on the impaired list and re-evaluate its reporting category status in future reports.

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5 [Footnote from previous page] 18 Rivers/Tributaries have "(NA)" entries under **Segment ID** and **Segment Length (miles).** This means that Guam EPA did not have an existing monitoring station at that location and that surface water quality was not assessed.

Table 21. 2008 Assessment Data for Coastal/Recreational Waters

Water Name	Assessment Unit ID	Location	State	Water Type	Water Size	Unit	Water Status	Reporting Category
Tarague and Scout Beach	GU-GB1	Tarague and Scout Beach	GU	COASTAL WATERS	3.42	MILES	NOT ASSESSED	3
Jinapsan Beach	GU-GB3	Jinapsan Beach	GU	COASTAL WATERS	1.28	MILES	NOT ASSESSED	3
Ritidian Beach	GU-GB4	Ritidian Beach	GU	COASTAL WATERS	2.21	MILES	NOT ASSESSED	3
Uruno Beach	GU-GB5	Uruno Beach	GU	COASTAL WATERS	1.74	MILES	NOT ASSESSED	3
Falcona Beach (Urunao)	GU-GB6	Falcona Beach (Urunao)	GU	COASTAL WATERS	0.37	MILES	NOT ASSESSED	3
South of Falcona Beach (Urunao)	GU-GB7	South of Falcona Beach (Urunao)	GU	COASTAL WATERS	0.24	MILES	NOT ASSESSED	3
Haputo Beach	GU-GB8	Haputo Beach	GU	COASTAL WATERS	0.19	MILES	NOT ASSESSED	3
Intermittent Beach - Shark's Hole	GU-GB9	Intermittent Beach - Shark's Hole	GU	COASTAL WATERS	0.19	MILES	NOT ASSESSED	3
Intermittent Beach - Tanguisson Pt.	GU-GB10	Intermittent Beach - Tanguisson Pt.	GU	COASTAL WATERS	0.26	MILES	NOT ASSESSED	3
Intermittent Beach - North of NCS/Tanguisson	GU-GB11	Intermittent Beach - North of NCS/Tanguisson	GU	COASTAL WATERS	0.26	MILES	NOT ASSESSED	3
Fafai Beach	GU-GB13	Fafai Beach	GU	COASTAL WATERS	0.37	MILES	NOT ASSESSED	3
Alupang Island Beach, East Hagatna Bay	GU-GB21	Alupang Island Beach, East Hagatna Bay	GU	COASTAL WATERS	0.02	MILES	NOT ASSESSED	3
West of volcanic headland, Asan Bay	GU-GB29	West of volcanic headland, Asan Bay	GU	COASTAL WATERS	0.37	MILES	NOT ASSESSED	3
Ski Beach	GU-GB38	Ski Beach	GU	COASTAL WATERS	0.4	MILES	NOT ASSESSED	3
SRF Beach	GU-GB40	SRF Beach	GU	COASTAL WATERS	0.4	MILES	NOT ASSESSED	3
Marianas Yacht Club Beach, Sasa Bay	GU-GB41	Marianas Yacht Club Beach, Sasa Bay	GU	COASTAL WATERS	0.18	MILES	NOT ASSESSED	3
Polaris Beach	GU-GB42	Polaris Beach	GU	COASTAL WATERS	0.19	MILES	NOT ASSESSED	3
Gabgab Beach	GU-GB43	Gabgab Beach	GU	COASTAL WATERS	0.65	MILES	NOT ASSESSED	3
Orote Point Beaches	GU-GB44	Orote Point Beaches	GU	COASTAL WATERS	0.46	MILES	NOT ASSESSED	3
Tipalao Beach	GU-GB45	Tipalao Beach	GU	COASTAL WATERS	0.15	MILES	NOT ASSESSED	3
Dadi Beach	GU-GB46	Dadi Beach	GU	COASTAL WATERS	0.57	MILES	NOT ASSESSED	3
Rizal Beach	GUS-01	Rizal Beach	GU	COASTAL WATERS	0.26	MILES	NOT ASSESSED	3
Apaca Park Beach	GU-GB48	Apaca Park Beach	GU	COASTAL WATERS	0.14	MILES	NOT ASSESSED	3
Salinas Beach	GU-GB51	Salinas Beach	GU	COASTAL WATERS	0.49	MILES	NOT ASSESSED	3

Table 21. 2008 Assessment Data for Coastal/Recreational Waters

Water Name	Assessment Unit ID	Location	State	Water Type	Water Size	Unit	Water Status	Reporting Category
Beach North of Finile River	GU-GB52	Beach North of Finile River	GU	COASTAL WATERS	0.3	MILES	NOT ASSESSED	3
Taelayag Beach	GU-GB56	Taelayag Beach	GU	COASTAL WATERS	0.87	MILES	NOT ASSESSED	3
Sagua Beach	GU-GB57	Sagua Beach	GU	COASTAL WATERS	0.62	MILES	NOT ASSESSED	3
Facpi Point Beaches	GU-GB58	Facpi Point Beaches	GU	COASTAL WATERS	0.66	MILES	NOT ASSESSED	3
Beach south of Achugao	GU-GB59	Beach south of Achugao	GU	COASTAL WATERS	0.29	MILES	NOT ASSESSED	3
Beach south of Agaga River	GU-GB60	Beach south of Agaga River	GU	COASTAL WATERS	0.25	MILES	NOT ASSESSED	3
Beach north of Asmafines River	GU-GB62	Beach north of Asmafines River	GU	COASTAL WATERS	0.12	MILES	NOT ASSESSED	3
Beach south of Sella River	GU-GB63	Beach south of Sella River	GU	COASTAL WATERS	0.12	MILES	NOT ASSESSED	3
Abong Beach	GU-GB64	Abong Beach	GU	COASTAL WATERS	0.62	MILES	NOT ASSESSED	3
Mouth of Cetti Bay	GU-GB65	Mouth of Cetti Bay	GU	COASTAL WATERS	0.5	MILES	NOT ASSESSED	3
Head of Fouha Bay	GU-GB66	Head of Fouha Bay	GU	COASTAL WATERS	0.06	MILES	NOT ASSESSED	3
South of Machadgan Point	GU-GB68	South of Machadgan Point	GU	COASTAL WATERS	0.25	MILES	NOT ASSESSED	3
Ajmo Beach	GU-GB70	Ajmo Beach	GU	COASTAL WATERS	0.16	MILES	NOT ASSESSED	3
Bile Bay Beach	GU-GB71	Bile Bay Beach	GU	COASTAL WATERS	0.03	MILES	NOT ASSESSED	3
Pigua River Beach	GU-GB72	Pigua River Beach	GU	COASTAL WATERS	0.08	MILES	NOT ASSESSED	3
Cocos Island	GU-GB73	Cocos Island	GU	COASTAL WATERS	1.16	MILES	NOT ASSESSED	3
Islet	GU-GB74	Islet	GU	COASTAL WATERS	0.07	MILES	NOT ASSESSED	3
Piga Beach/Talona Beach	GU-GB76	Piga Beach/Talona Beach	GU	COASTAL WATERS	0.42	MILES	NOT ASSESSED	3
Aba Beach	GU-GB78	Aba Beach	GU	COASTAL WATERS	0.19	MILES	NOT ASSESSED	3
Aang Beach	GU-GB79	Aang Beach	GU	COASTAL WATERS	0.12	MILES	NOT ASSESSED	3
ACHANG BAY	GU-GB80	ACHANG BAY	GU	COASTAL WATERS	0.55	MILES	NOT ASSESSED	3
Beach to Liyog River Mouth	GU-GB81	Beach to Liyog River Mouth	GU	COASTAL WATERS	0.77	MILES	NOT ASSESSED	3
Liyog river Mouth	GU-GB82	Liyog river Mouth	GU	COASTAL WATERS	0.18	MILES	NOT ASSESSED	3
Beach to Asgadao Bay	GU-GB83	Beach to Asgadao Bay	GU	COASTAL WATERS	0.04	MILES	NOT ASSESSED	3
Intermittent Beach 1, Asgadao Bay	GU-GB84	Intermittent Beach 1, Asgadao Bay	GU	COASTAL WATERS	0.12	MILES	NOT ASSESSED	3

Table 21. 2008 Assessment Data for Coastal/Recreational Waters

Water Name	Assessment Unit ID	Location	State	Water Type	Water Size	Unit	Water Status	Reporting Category
Intermittent Beach 2, Asgadao Bay	GU-GB85	Intermittent Beach 2, Asgadao Bay	GU	COASTAL WATERS	0.12	MILES	NOT ASSESSED	3
Intermittent Beach 3, Asgadao Bay	GU-GB86	Intermittent Beach 3, Asgadao Bay	GU	COASTAL WATERS	0.09	MILES	NOT ASSESSED	3
Ajayan River Mouth	GU-GB87	Ajayan River Mouth	GU	COASTAL WATERS	0.03	MILES	NOT ASSESSED	3
Intermittent Beach 4, Asgadao Bay	GU-GB88	Intermittent Beach 4, Asgadao Bay	GU	COASTAL WATERS	0.19	MILES	NOT ASSESSED	3
Ajayan River Mouth	GU-GB89	Ajayan River Mouth	GU	COASTAL WATERS	0.06	MILES	NOT ASSESSED	3
Intermittent beach at AJAYAN BAY	GU-GB90	Intermittent beach at AJAYAN BAY	GU	COASTAL WATERS	0.09	MILES	NOT ASSESSED	3
Aga Beach	GU-GB91	Aga Beach	GU	COASTAL WATERS	0.08	MILES	NOT ASSESSED	3
Guijen Rock area	GU-GB92	Guijen Rock area	GU	COASTAL WATERS	0.44	MILES	NOT ASSESSED	3
Atao Beach	GU-GB93	Atao Beach	GU	COASTAL WATERS	0.38	MILES	NOT ASSESSED	3
Beach north of Acho Point	GU-GB94	Beach north of Acho Point	GU	COASTAL WATERS	0.27	MILES	NOT ASSESSED	3
Agfayan River Beach	GU-GB95	Agfayan River Beach	GU	COASTAL WATERS	0.07	MILES	NOT ASSESSED	3
Beach at Paulilluc Bay	GU-GB98	Beach at Paulilluc Bay	GU	COASTAL WATERS	0.28	MILES	NOT ASSESSED	3
ULOMAI BEACH	GU-GB99	ULOMAI BEACH	GU	COASTAL WATERS	0.11	MILES	NOT ASSESSED	3
Perez Beach	GU-GB101	Perez Beach	GU	COASTAL WATERS	0.26	MILES	NOT ASSESSED	3
Asiga Beach Area (Inarajan)	GU-GB102	Asiga Beach Area (Inarajan)	GU	COASTAL WATERS	0.23	MILES	NOT ASSESSED	3
Head of Paicpouc Cove	GU-GB103	Head of Paicpouc Cove	GU	COASTAL WATERS	0.09	MILES	NOT ASSESSED	3
Calvos Beach	GU-GB108	Calvos Beach	GU	COASTAL WATERS	0.51	MILES	NOT ASSESSED	3
Jones Beach	GU-GB110	Jones Beach	GU	COASTAL WATERS	0.09	MILES	NOT ASSESSED	3
North of Togcha Point	GU-GB114	North of Togcha Point	GU	COASTAL WATERS	1.03	MILES	NOT ASSESSED	3
Head of Ylig Bay	GU-GB115	Head of Ylig Bay	GU	COASTAL WATERS	0.18	MILES	NOT ASSESSED	3
Beach North of Ylig Bay	GU-GB116	Beach North of Ylig Bay	GU	COASTAL WATERS	0.07	MILES	NOT ASSESSED	3
North Pago Bay Beach	GU-GB119	North Pago Bay Beach	GU	COASTAL WATERS	0.24	MILES	NOT ASSESSED	3
Asan Bay Beach	GUN-14	Asan Memorial Beach, Head of Asan Bay	GU	COASTAL WATERS	0.53	MILES	IMPAIRED	5
Bangi Beach	GUS-04	Beach South of Finile River	GU	COASTAL WATERS	1.17	MILES	IMPAIRED	5

Table 21. 2008 Assessment Data for Coastal/Recreational Waters

Water Name	Assessment Unit ID	Location	State	Water Type	Water Size	Unit	Water Status	Reporting Category
Adelup Beach Park	GUN-21	Beach at Fonte River, West Hagatna Bay	GU	COASTAL WATERS	0.13	MILES	IMPAIRED	5
Inarajan Bay	GUS-10	Beach at Inarajan Bay	GU	COASTAL WATERS	0.42	MILES	IMPAIRED	5
Beach at Pago Bay	GUS-15	Pago Bay	GU	COASTAL WATERS	0.96	MILES	IMPAIRED	5
Santos Memorial Park	GUN-16	Beach at Piti Bay	GU	COASTAL WATERS	0.39	MILES	IMPAIRED	5
Piti Bay	GUN-15		GU	COASTAL WATERS	0.46	MILES	IMPAIRED	5
Togcha Bay	GUS-13	Beach North of Togcha River	GU	COASTAL WATERS	0.27	MILES	IMPAIRED	5
Dungca's Beach - Sleepy Lagoon	GUN-06	Dungca's Beach East Hagatna Bay	GU	COASTAL WATERS	0.46	MILES	IMPAIRED	5
Dungca's Beach	GUN-07		GU	COASTAL WATERS	0.46	MILES	IMPAIRED	5
Family Beach	GUN-19	Family Beach	GU	COASTAL WATERS	0.15	MILES	IMPAIRED	5
Ipan Point Beach	GUS-18	First Beach	GU	COASTAL WATERS	0.06	MILES	IMPAIRED	5
Gongna Beach -North San Vitores	GUN-25	Gongna Beach, Tumon Bay	GU	COASTAL WATERS	0.14	MILES	IMPAIRED	5
Gun Beach	GUN-24	Gun Beach, Tumon Bay	GU	COASTAL WATERS	0.23	MILES	IMPAIRED	5
Hagatna Channel -Outrigger Ramp	GUN-11	Hagatna Marina	GU	COASTAL WATERS	0.15	MILES	IMPAIRED	5
Hagatna Boat Basin	GUN-12		GU	COASTAL WATERS	0.12	MILES	IMPAIRED	5
Hagatna Channel	GUN-10		GU	COASTAL WATERS	0.15	MILES	IMPAIRED	5
Talofofo Bay	GUS-11	Head of Talofofo Bay	GU	COASTAL WATERS	0.21	MILES	IMPAIRED	5
Umatac Bay	GUS-06	Head of Umatac Bay	GU	COASTAL WATERS	0.14	MILES	IMPAIRED	5
Inarajan Pool	GUS-09	Inarajan Pools	GU	COASTAL WATERS	0.07	MILES	IMPAIRED	5
Merizo Pier -Mamaon Channel	GUS-08	Merizo Public Pier Park	GU	COASTAL WATERS	0.46	MILES	IMPAIRED	5
Tanguisson Beach	GUN-01	NCS Beach /Tanguisson Beach	GU	COASTAL WATERS	0.25	MILES	IMPAIRED	5
Naton Beach -Guma Trankilidat	GUN-04	Naton Beach, Tumon Bay	GU	COASTAL WATERS	0.4	MILES	IMPAIRED	5
Naton Beach -San Vitores	GUN-02		GU	COASTAL WATERS	0.39	MILES	IMPAIRED	5
Naton Beach -Fujita	GUN-23		GU	COASTAL WATERS	0.29	MILES	IMPAIRED	5
Naton Beach -Matapang Beach Park	GUN-03		GU	COASTAL WATERS	0.3	MILES	IMPAIRED	5
Nimitz Beach	GUS-05	Nimitz Beach	GU	COASTAL WATERS	0.49	MILES	IMPAIRED	5
Outhouse Beach	GUN-18	Outhouse Beach	GU	COASTAL WATERS	0.46	MILES	IMPAIRED	5
Port Authority Beach	GUN-20	Port Authority Beach	GU	COASTAL WATERS	0.46	MILES	IMPAIRED	5
Tagachang Beach Park	GUS-14	Tagachang Beach	GU	COASTAL WATERS	0.07	MILES	IMPAIRED	5
Toguan Bay	GUS-07	Toguan Bay	GU	COASTAL WATERS	0.46	MILES	IMPAIRED	5

Table 21. 2008 Assessment Data for Coastal/Recreational Waters

Water Name	Assessment Unit ID	Location	State	Water Type	Water Size	Unit	Water Status	Reporting Category
Togcha Beach Southern Christian Academy	GUS-17	Togcha Beach -aka Agat Beach	GU	COASTAL WATERS	0.31	MILES	IMPAIRED	5
Togcha Beach Namo Bay	GUS-02		GU	COASTAL WATERS	0.33	MILES	IMPAIRED	5
Togcha Bay Agat Beach	GUS-03		GU	COASTAL WATERS	0.15	MILES	IMPAIRED	5
Trinchera Beach, East Hagatna Bay	GUN-08	Trinchera Beach East Hagatna Bay	GU	COASTAL WATERS	0.46	MILES	IMPAIRED	5
Trinchera Beach, Alupang Beach Towers	GUN-26		GU	COASTAL WATERS	0.19	MILES	IMPAIRED	5
Padre P alomo	GUN-09		GU	COASTAL WATERS	0.46	MILES	IMPAIRED	5
United Seamen's Service Beach (USO Beach)	GUN-17	United Seamen's Service	GU	COASTAL WATERS	0.52	MILES	IMPAIRED	5
West Hagatna Beach	GUN-13	Hagatna Bayside	GU	COASTAL WATERS	1.11	MILES	IMPAIRED	5
West of Adelup Point, Asan Bay	GUN-22	Beach West of Adelup	GU	COASTAL WATERS	0.41	MILES	IMPAIRED	5
Ypan Beach Park Beach (Ipan Public Beach)	GUS-12	Ipan Beach	GU	COASTAL WATERS	0.3	MILES	IMPAIRED	5
Ypao Beach,Tumon Bay	GUN-05	Ypao Beach	GU	COASTAL WATERS	0.42	MILES	IMPAIRED	5

Table 21 provides assessment data for monitored Coastal/Recreational Waters. Forty-two (42) Tier 1 Beach Stations were monitored and placed in Reporting Category 5 because data indicated that at least one designated use was not being supported or was threatened. These beaches are included in Guam's 2008 303(d) list of impaired/threatened waters (**Table 23**).

Table B5c. in Appendix B identifies the Various Cause/Stressor Categories for Guam recreational beaches, i.e. Pesticides, PCBs, Unknown, Siltation, etc. The applicable category with available data was "Pathogen Indicators". The size of recreational beaches impaired by pathogens was 8.68 shoreline miles in 2006 and 8.91 shoreline miles in 2007.

Table B6c. in Appendix B identifies the Various Source Categories for Guam recreational beaches, i.e. Industrial Point Sources, Construction, Natural Sources, etc. No data was available to determine the size of waters impaired as a result of applicable source categories.

1.2.2. *Marine Bays – Table 21-A*

No Marine Bays were assessed during the reporting period. However, Marine Bays reported under Category 5 are either under an Advisory or were assessed in a previous reporting period, 303(d) listed and a TMDL has yet to be developed. **Refer to Table 21-A. and Table 23.**

Table B5b in Appendix B shows applicable Categories of Causes/Stressors (i.e. Unknown toxicity, Pesticides, PCBs, etc.) which contribute to the impairment of Guam's Marine Bays. There is limited data available to determine the size of waters impaired by these various categories of Causes/Stressors.

Table B6b in Appendix B shows the applicable Source Categories (i.e. Industrial Point Sources, Combined Sewer Overflows, Agriculture, etc.) which contribute to the impairment of Guam's Marine Bays. There is limited data available to determine the size of waters impaired by these various Source Categories.

2.0 Results of Probability-based Surveys

Table 22 lists Guam EPA monitoring projects which use probability-based surveying. GCA-05 project data is still under QA/QC evaluation; and the GWSA-06 project is still being implemented. Attainment results from these surveys are still under analysis and could not be included in this report. The dashes (-) in **Table 22** denote that "no data is available for the applicable category".

Table 21-A. Assessment Data for Marine Bays

Water Name	Assessment Unit ID	WATERSHED Location	STATE	Water Type	Water Size	Unit	Water Status	Reporting Category
AGAT BAY	GUG-010B	AGAT	GU	MARINE BAY	1.73	SQUARE MILES	IMPAIRED	5
TIPALEO BAY	GUG-010A	AGAT	GU	MARINE BAY	0.08	SQUARE MILES	NOT ASSESSED	3
APRA HARBOR 1	GUG-008A	APRA	GU	MARINE BAY	6.11	SQUARE MILES	IMPAIRED	5
COCOS LAGOON 1 (Mamaon & Manell Channel)	GUG-020A	GEUS	GU	MARINE BAY	5.24	SQUARE MILES	IMPAIRED	5
CETTI BAY	GUG-014A	CETTI	GU	MARINE BAY	0.09	SQUARE MILES	NOT ASSESSED	3
PAGO BAY	GUG-003A	PAGO	GU	MARINE BAY	0.73	SQUARE MILES	IMPAIRED	5
WEST HAGATNA BAY 1	GUG-002A	AGANA	GU	MARINE BAY	0.93	SQUARE MILES	NOT ASSESSED	3
AGFAYAN BAY	GUG-017C	INARAJAN	GU	MARINE BAY	0.08	SQUARE MILES	NOT ASSESSED	3
EAST HAGATNA BAY	GUG-001D	NORTHERN	GU	MARINE BAY	1.24	SQUARE MILES	NOT ASSESSED	3
DOUBLE REEF	GUG-001A	NORTHERN	GU	MARINE BAY	0.1	SQUARE MILES	NOT ASSESSED	3
TANGUISSON BEACH	GUG-001B	NORTHERN	GU	MARINE BAY	0.64	SQUARE MILES	NOT ASSESSED	3
TALEYFAC BAY 1	GUG-012A	TAELAYAG	GU	MARINE BAY	1.39	SQUARE MILES	NOT ASSESSED	3
TALOFOFO BAY	GUG-007A	TALOFOFO	GU	MARINE BAY	0.14	SQUARE MILES	NOT ASSESSED	3
TOGCHA BAY	GUG-007A	TOGCHA	GU	MARINE BAY	0.61	SQUARE MILES	NOT ASSESSED	3
TUMON BAY	GUG-001C	NORTHERN	GU	MARINE BAY	0.96	SQUARE MILES	IMPAIRED	5
UMATAC BAY	GUG-016B	UMATAC	GU	MARINE BAY	0.07	SQUARE MILES	NOT ASSESSED	3
FOUHA BAY	GUG-016A	UMATAC	GU	MARINE BAY	0.02	SQUARE MILES	NOT ASSESSED	3
YLIG BAY	GUG-005A	YLIG	GU	MARINE BAY	0.33	SQUARE MILES	NOT ASSESSED	3

Table 22. Attainment Results Calculated Using Probabilistic Monitoring Designs

Project ID	GCA-05	GWSA-06
Project Name	Guam Coastal Assessment	Guam Wadeable Stream Assessment
Target Population	60 foot depth contour to MLLW	All Rivers of Guam
Type of Waterbody	Coastal	Rivers
Size of Target Population	50	112
Units of Measurement	Shoreline Miles	River Miles
Designated Use	Aquatic life	Aquatic Life
Percent Attaining	-	-
Percent Not Attaining	-	-
Percent No response	-	-
Indicator	Biological/Chemical/Physical	Biological/Chemical/Physical
Assessment Date	November 2004 to August 2005	January 2006 to present
Precision	-	-

3.0 Section 303(d) List

The Clean Water Act and EPA regulations require Guam to submit a list of water quality-limited (impaired and threatened) waters still requiring Total Maximum Daily Loads (TMDLs), the pollutants causing the impairment, and priority ranking for TMDL development. Guam's 303(d) list for 2008 is provided in **Table 23**.

Guam EPA followed the EPA's 1997 and 2006 Integrated Report Guidance in evaluating available data/information and identifying impaired waters. Guam EPA considered how data was collected and analyzed and placed greater weight on data collected using approved quality assurance/quality control plans and procedures.

The following criteria were used to identify waters as impaired:

- 10% of annual samples of conventional pollutant (e.g., bacteria, sediment, and nutrients) exceeded currently applicable Guam numeric water quality standards;
- Numeric water quality standards for toxic pollutants were exceeded in two or more samples collected in any three year period;
- Aquatic sediment and/or fish tissue data results indicated that pollutants were present in sediment and/or fish tissue at levels of concern or at levels that exceed commonly applied screening guidelines;
- Coral reef assessment results found that the health of individual reef and lagoon areas were impaired due to pollutant discharges, such as sediment runoff from the land and groundwater discharge high in nutrients;
- Other data and information indicated that a specific water quality standard was exceeded based on the professional judgment of Guam EPA staff.

All waterbody and pollutant listings received a priority ranking of high, medium, or low. Waters with high priority rankings will be targeted for TMDL development within the next two years as required by 40 CFR 130.7. Guam EPA intends to work with interested parties and EPA to determine the schedule for future TMDL development.

Guam has one approved TMDL. (See Appendix F.) EPA is providing technical assistance to Guam EPA for the development of a Bacteria TMDL for impaired Tier I beaches.

For all waters identified for inclusion on the Section 303(d) impaired waters list, the Agency set priority rankings to guide Total Maximum Daily Load (TMDL) development. [TMDLs identify allowable pollutant loads to a waterbody, from both point and non-point sources, that will prevent a violation of water quality standards. When TMDLs are developed, the causes of water quality problems are able to be determined.]

TMDL Priority rankings were set based on the Guam EPA staff judgments concerning:

- The importance of uses to be made of the water;
- The magnitude of incidences observed;
- The fit of TMDL development work with other assessment, planning, or pollution control activities planned by the Agency; and
- The degree of public interest in or concern about the water body.

3.1 A Comparison of Guam's 2008 and 2006 303(d) Lists

The format of 2008 IR assessment tables 20, 21, 21-A, and 23 were modified to align Guam's data with information required in EPA's Assessment Data Base. Guam EPA has yet to establish a compatible electronic reporting system to assist Guam in meeting IR deadlines.

3.1.1 *Waterbody Type: Coastal, Bay/Estuary, Bay, River, Wetland*

EPA approved Guam's 2006 303(d) List on November 28, 2007 and reported those impaired waters under the waterbody types discussed below.[6] One marine bay, Cocos Lagoon, was added to Guam's 2008 303(d) list due to a Fish Advisory issued during 2006-2007. Waters previously reported in the 2006 List as *Agana River/Bay* and *Pago River/Bay* are separated and placed under the appropriate water type for the 2008 303(d) list, based on a review of pertinent available data.

COASTAL

- 42 coastal/recreational assessment units were categorized as *impaired* for both the 2008 and 2006 303(d) lists;
- The pollutant for these waterbodies is specifically identified in **Table 23** as *Enterococcus*; the 2006 pollutant entry was *bacteria*.
- The sizes of all coastal assessment units were provided in both years and can be found in **Table 21** for the current reporting period.

6 2006 Section 303(d) List Fact Sheet for GUAM | WATERS | US EPA

BAY/ESTUARY

The impaired bay/estuary waters on the 2006 List were Agana River/Bay, Agat Bay, and Apra Harbor.

- *Agana River/Bay*
  This entry is re-named **"Hagatna River"** in the 2008 report, assessment unit **GUAGRA-3**. In 2006, the identified pollutants were turbidity and dissolved oxygen. An evaluation of available pollutant assessment data revealed that the impairment of the Hagatna River was caused by enterococcus and dissolved oxygen violations of the GWQS. [*A review of 1997 and 1998 turbidity data revealed that the prior assessment used the GWQS: "not>1 NTU"; the appropriate GWQS is "not>1.0 NTU above ambient". Averaging Turbidity values at all the Hagatna River stations from 1978-1991 resulted in an ambient value of 5.8 NTU. Assessing 1997 and 1998 values against the ambient criteria resulted in zero (0) violations of the Turbidity parameter. Turbidity has been cited (in error) as a pollutant to this waterbody*.]
- *Agat Bay*
  Agat Bay waters remain impaired as previously listed in 2006. The assessment unit ID for this bay is **GUG-010B**. The size of the bay is 1.73 square miles and the pollutants listed in the 2008 List are: PCBs in fish tissue, chlordane in fish tissue and dioxins in fish tissue.
- *Apra Harbor*
  Apra Harbor waters remain impaired as previously listed in 2006. The assessment unit ID for this bay is **GUG-008A**. The size of the bay is 6.11 square miles and the pollutants are listed in 2008 as PCBs in fish tissue.

BAY

The bay waters listed in 2006 were Tumon Bay, Pago River/Bay, and Agana River/Bay.

- *Tumon Bay*
  More information about Tumon Bay is included in **Table 23**. The assessment unit ID is **GUG-001C** and size of this bay is 0.96 square miles. The 2006 listing of pollutants as "toxic contaminants" has been changed to specifically name these pollutants in **Table 23**. Nutrients and bacteria, 2006 pollutants, are <u>not</u> listed for the 2008 reporting period. [*Tumon nitrates data showed violations above ambient from the 2001 sampling effort at 6 violations of 119 samples (not at the >10% level). Ortho-phosphate was another nutrient analyzed, but it did not show any violations. Ammonia was analyzed where 1 sample of 119 samples was elevated above 0.1 mg/L, but Guam does not have a standard for ammonia. The analysis of the 2001 data did not substantiate listing Tumon as nutrient impaired. 2002 and 2003 data for Enterococcus actually defined the impairment of <u>recreational waters</u> and not marine waters. Five (5) Tumon Bay recreational water assessment units are listed as impaired for both 2006 and 2008: GUN-04, GUN-02, GUN-23, GUN-03, and GUN-05 (see Table 23., page 2)*].
- *Pago River/Bay*
  This entry is renamed **Pago Bay**, assessment unit **GUG-003A** which is assessed via six monitoring stations. The size of Pago Bay is 0.73 square miles. Based on

the 1997 and 1998 data for the parameter Enterococcus, the entire Bay is impaired. Two monitoring locations were identified as having additional pollutants: dissolved oxygen and nitrate. Although Turbidity was listed as a pollutant in 2006, Guam does not include turbidity as a pollutant for Pago Bay in its 2008 303(d) list. *[1997 and 1998 data show that the assessment was conducted using GWQS as "not > 1 NTU". GWQS is "not > 1 NTU above ambient". Averaging the Turbidity values at all the Pago Bay marine stations from 1980-1990 resulted in an ambient value of above 2 NTU. So assessing 1997 and 1998 values against the ambient criteria resulted in zero (0) violations of the Turbidity parameter.]* From the analysis of 2002 and 2003 data of the parameter Enterococcus, Guam EPA determined that exceedances for bacteria samples were from one Pago Bay beach assessment unit: GUS-15, which is already listed for bacteria.

- *Agana River/Bay*
  Guam does not include East Hagatna Bay in its 2008 303(d) List. The only pollutant substantiated by the historical data as causing impairment in East Hagatna Bay is Enterococus. However, the data for this pollutant is actually for *recreational/coastal waters* in the east bay (GUN-06, GUN-07, GUN-08, GUN-26, and GUN-09; these assessment units are 303(d) listed for 2006 and 2008) and not the marine waters. Turbidity and dissolved oxygen were listed as pollutants for 2006 but are de-listed for the 2008 reporting period. [Historical data notes that East Hagatna Bay marine station AGMP as impaired for turbidity; however, the evaluation of the respective turbidity data based on GWQS, did not result in the categorization of this station as impaired. A review of the dissolved oxygen data found that in 1997-1998-1999, of the 61 samples obtained in the Bay, there were 2 violations. This is within GWQS.]
- *Cocos Lagoon*
  This marine water is added to the Guam 2008 303(d) List as assessment unit ID **GUG-020A**, 5.24 square miles in size. The pollutant is PCBs in fish tissue.

RIVER

Two waters listed as a river in the 2006 reporting period: the Lonfit River segment and the Pago River segment. For 2008, these waters are assigned assessment unit IDs and additional waters are added to this waterbody type as discussed below.

- *Lonfit River*
  There are two Lonfit River assessment units (**GUPGRL-2 and GUPGRL-1-51B**) associated with the specific leachate pollutants listed in Table 23, page 39e (5). The sizes of these waters are also provided.
- *Pago River*
  The separation of the Pago River/Bay waters resulted in the addition of one river water assessment unit ID: Pago River **GUPGRP-2**. Pago River assessment unit ID: **GUPGRP-1** is carried over from the 2006 303(d) list. These waters are impaired for bacteria, specifically E. coli. A second pollutant, dissolved oxygen, was recorded at levels exceeding GWQS at river assessment unit ID: GUPGRP-2.

Evaluation of respective turbidity data based on GWQS did not result in the categorization of these stations as "impaired'. **Guam does not include ***turbidity*** as a pollutant for the Pago River in its 2008 303(d) List.**

- *Landfill Leachate Stream*
  The 1996-1997 narrative discussing the impairments in what was known as the PAGO RIVER COMPLEX cites that the nitrate, dissolved oxygen and E. coli violations occurred at an upstream monitoring site, assessment unit ID: **GUPGRL-0**, on the Lonfit River. This assessment unit has been added to the 2008 303(d) List, water name: **Landfill Leachate Stream**, 0.05 river miles in size.

WETLAND

- *Agana Swamp*
  Assessment unit ID: **GUG-1B** is forwarded onto the Guam 2008 303(d) List of impaired waters from 2006. The pollutant is PCBs in fish tissue.

4.0 Clean Lakes Program

Guam does not have any publicly owned lakes. The largest open body of fresh water on the island is the **Fena Reservoir,** constructed by the Navy in 1951 as a source of drinking water supply; and located in the watershed area on the eastern slope in southern Guam, having an impoundment capacity of approximately 7,182 acre-feet and a surface area of 195 acres. Besides rainwater in the watershed, it receives a water supply supplement from Almagosa and Bona Springs. Water from these sources is pre-chlorinated before dosing with aluminum sulfate and lime for coagulation. The water then flows into a clarifier where the settled solids are discharged and the clarified water flows to filters for removal of the remaining turbidity. After filtration, the water is chlorinated for disinfection. Fena Reservoir supplies water, via its own treatment plant, to the U.S. Navy operations and personnel as well as military dependents; GWA purchases water from the Navy for the civilian population. Fena Reservoir's fresh water is classified as "S-1" water, designated for drinking water (without treatment), aquatic life and human consumption.

FENA RESERVOIR, GUAM

Table 23. 2008 Guam 303(d) List

Water Name	Assessment Unit ID	Location	State	Water Type	Water Size	Unit	Pollutants	Basis for Listing	Priority Ranking
Asan Bay Beach	GUN-14	Asan Memorial Beach, Head of Asan Bay	GU	COASTAL WATERS	0.53	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Bangi Beach	GUS-04	Beach South of Finile River	GU	COASTAL WATERS	1.17	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Adelup Beach Park	GUN-21	Beach at Fonte River, West Hagatna Bay	GU	COASTAL WATERS	0.13	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Inarajan Bay	GUS-10	Beach at Inarajan Bay	GU	COASTAL WATERS	0.42	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Beach at Pago Bay	GUS-15	Pago Bay	GU	COASTAL WATERS	0.96	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Santos Memorial Park	GUN-16	Beach at Piti Bay	GU	COASTAL WATERS	0.39	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Piti Bay	GUN-15		GU	COASTAL WATERS	0.46	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Togcha Bay	GUS-13	Beach North of Togcha River	GU	COASTAL WATERS	0.27	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Dungca's Beach - Sleepy Lagoon	GUN-06	Dungca's Beach East Hagatna Bay	GU	COASTAL WATERS	0.46	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Dungca's Beach	GUN-07		GU	COASTAL WATERS	0.46	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Ipan Point Beach	GUS-18	First Beach	GU	COASTAL WATERS	0.06	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Gongna Beach -North San Vitores	GUN-25	Gongna Beach, Tumon Bay	GU	COASTAL WATERS	0.14	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Hagatna Channel	GUN-10	Hagatna Marina	GU	COASTAL WATERS	0.15	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Hagatna Channel -Outrigger Ramp	GUN-11		GU	COASTAL WATERS	0.15	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Hagatna Boat Basin	GUN-12		GU	COASTAL WATERS	0.12	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH

Table 23. 2008 Guam 303(d) List

Water Name	Assessment Unit ID	Location	State	Water Type	Water Size	Unit	Pollutants	Basis for Listing	Priority Ranking
Gun Beach	GUN-24	Gun Beach, Tumon Bay	GU	COASTAL WATERS	0.23	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Talofofo Bay	GUS-11	Head of Talofofo Bay	GU	COASTAL WATERS	0.21	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Umatac Bay	GUS-06	Head of Umatac Bay	GU	COASTAL WATERS	0.14	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Inarajan Pool	GUS-09	Inarajan Pools	GU	COASTAL WATERS	0.07	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Merizo Pier -Mamaon Channel	GUS-08	Merizo Public Pier Park	GU	COASTAL WATERS	0.46	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Tanguisson Beach	GUN-01	NCS Beach /Tanguisson Beach	GU	COASTAL WATERS	0.25	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Naton Beach -Guma Trankilidat	GUN-04	Naton Beach, Tumon Bay	GU	COASTAL WATERS	0.4	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Naton Beach -San Vitores	GUN-02		GU	COASTAL WATERS	0.39	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Naton Beach -Fujita	GUN-23		GU	COASTAL WATERS	0.29	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Naton Beach -Matapang Beach Park	GUN-03		GU	COASTAL WATERS	0.3	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Nimitz Beach	GUS-05	Nimitz Beach	GU	COASTAL WATERS	0.49	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Outhouse Beach	GUN-18	Outhouse Beach	GU	COASTAL WATERS	0.46	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Port Authority Beach	GUN-20	Port Authority Beach	GU	COASTAL WATERS	0.46	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Tagachang Beach	GUS-14	Tagachang Beach Park	GU	COASTAL WATERS	0.07	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Toguan Bay	GUS-07	Toguan Bay	GU	COASTAL WATERS	0.46	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH

Table 23. 2008 Guam 303(d) List

Water Name	Assessment Unit ID	Location	State	Water Type	Water Size	Unit	Pollutants	Basis for Listing	Priority Ranking
Togcha Beach -Southern Christian Academy	GUS-17	Togcha Beach aka Agat Beach	GU	COASTAL WATERS	0.31	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Togcha Beach -Namo Bay	GUS-02		GU	COASTAL WATERS	0.33	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Togcha Beach -Agat Bay	GUS-03		GU	COASTAL WATERS	0.15	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
East Hagatna Bay -Trinchera Beach	GUN-08	Trinchera Beach, East Hagatna Bay	GU	COASTAL WATERS	0.46	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
East Hagatna Bay - Alupang Beach Towers	GUN-26		GU	COASTAL WATERS	0.19	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
East Hagatna Bay Padre Palomo	GUN-09		GU	COASTAL WATERS	0.46	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
United Seamen's Service	GUN-17	United Seamen's Service Beach (USO Beach)	GU	COASTAL WATERS	0.52	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Hagatna Bayside	GUN-13	West Hagatna Beach	GU	COASTAL WATERS	1.11	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Beach West of Adelup	GUN-22	West of Adelup Point, Asan Bay	GU	COASTAL WATERS	0.41	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Ipan Beach	GUS-12	Ypan Beach Park Beach (Ipan Public Beach)	GU	COASTAL WATERS	0.3	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Ypao Beach	GUN-05	Ypao Beach, Tumon Bay	GU	COASTAL WATERS	0.42	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Family Beach	GUN-19	Family Beach	GU	COASTAL WATERS	0.15	MILES	Enterococcus	Exceeds WQS >10%of Samples	HIGH
Hagatna River	GUAGRA-3	WATERSHED: Agana	GU	RIVER	0.52	MILES	Enterococcus, Dissolved Oxygen	Exceeds WQS >10%of Samples	LOW

Table 23. 2008 Guam 303(d) List

Water Name	Assessment Unit ID	Location	State	Water Type	Water Size	Unit	Pollutants	Basis for Listing	Priority Ranking
Agat Bay	GUG-010B	WATERSHED: Agat	GU	MARINE BAY	1.73	SQUARE MILES	PCBs in fish tissue, Chlordane in fish tissue, Dioxin in fish tissue	Fish Advisory (2001 & 2002)	LOW
Apra Harbor	GUG-008A	WATERSHED: Apra	GU	MARINE BAY	6.11	SQUARE MILES	PCBs in fish tissue	Fish Advisory (1999)	LOW
Cocos Lagoon	GUG-020A	WATERSHED: Geus	GU	MARINE BAY	5.24	SQUARE MILES	PCBs in fish tissue	Fish Advisory (2006)	LOW
Pago Bay	GUG-003A	WATERSHED: Pago	GU	MARINE BAY	0.73	SQUARE MILES	Enterococcus, Dissolved Oxygen, Nitrate	Exceeds WQS >10%of Samples	MEDIUM
Tumon Bay	GUG-001C	WATERSHED: Northern	GU	MARINE BAY	0.96	SQUARE MILES	Tetrachloroethene, Trichloroethylene, Antimony, Arsenic, Dieldrin, Total Chlordane	Waters Not Attaining Designated Uses	HIGH
Agana Swamp	GUG-1B	WATERSHED: Agana	GU	WETLAND	6.4	ACRES	PCBs in fish tissue	Fish Advisory (2001)	LOW
Landfill Leachate Stream	GUPGRL-0	WATERSHED: Pago	GU	RIVER	0.05	MILES	E. coli, Nitrate, Dissolved Oxygen	Exceeds WQS >10%of Samples	MEDIUM
Pago River 1	GUPGRP-1	WATERSHED: Pago	GU	RIVER	0.1	MILES	E. coli	Exceeds WQS >10%of Samples	MEDIUM
Pago River 2	GUPGRP-2	WATERSHED: Pago	GU	RIVER	4.73	MILES	E. coli, Dissolved Oxygen	Exceeds WQS >10%of Samples	MEDIUM

Table 23. 2008 Guam 303(d) List

Water Name	Assessment Unit ID	Location	State	Water Type	Water Size	Unit	Pollutants	Basis for Listing	Priority Ranking
Lonfit River 2	GUPGRL-2	WATERSHED: Pago	GU	RIVER	1.07	MILES	Aluminum, Salinity, Temperature, Nitrate, Ammonia, Total Coliform, E. coli, Enterococcus Iron, Manganese, Copper, Zinc, Chromium, Nickel, Total Suspended Solids, Total Dissolved Solids	Consent Decree	LOW
Lonfit River 3	GUPGRL-1-51B	WATERSHED: Pago	GU	RIVER	3.79	MILES	Aluminum, Salinity, Temperature, Nitrate, Ammonia, Total Coliform, E. coli, Enterococcus Iron, Manganese, Copper, Zinc, Chromium, Nickel, Total Suspended Solids, Total Dissolved Solids	Consent Decree	LOW

D. Wetlands Program

Guam Executive Order (EO) 90-13 and its predecessor EO 78-21 established the basis for an initial integrated wetland protection and management program among a handful of government agencies. These agencies included the Guam Coastal Management Program (GCMP) at the Bureau of Statistics and Plans, the Division of Aquatic and Wildlife Resources (DAWR) at the Department of Agriculture, the Department of Land Management and the Guam Environmental Protection Agency.

1.0 Program Description

The Guam Land Use Commission (GLUC), through its Wetland Area Rules and Regulations, is the permitting authority and the Department of Agriculture, DAWR provides lead technical support to the Commission under the permit system. The Guam EPA and other agencies provide technical review and recommendations to the Commission on wetland development permit applications through their membership on the Application Review Committee (ARC). The Agency also typically has the responsibility to oversee the environmental impact assessment procedures which must be part of many permit applications.

Guam EPA has maintained an array of program support functions in the area of wetland protection since approximately 1978. Aside from the 401 Water Quality Certification (permit), the Agency does not have a lead resource management or permitting role. Most of the functions listed are undertaken in support of both the GLUC and Army Corps of Engineers Section 404 permit systems. A substantial range of wetland development activities may require both federal and local permits. The following list of functions is mainly provided through the Agency's Planning and Review Division.

- Building permit and plan review
- Field inspections and delineation verification
- Field determinations
- Enforcement
- Planning
- Policy development
- Public awareness and education
- Consultation
- Section 401 WQC (federal permits only)

2.0 Wetlands Monitoring

As previously mentioned in this report, no monitoring efforts were undertaken during this reporting period. The Agency's 2006 Comprehensive Monitoring Strategy includes a ***Wetlands Monitoring Program***, which is discussed under the Monitoring Program narrative, **section III.A.3.4.** The Agency's stream/river monitoring program is likely to include an initial wetland monitoring strategy which may serve as a basis for establishing wetland water quality standards. Historically, wetlands water quality monitoring has been conducted only in relation to construction permit performance primarily for

sediment. Much of this type of monitoring was accomplished by visual observation since most projects were small. The largest construction monitoring project which examined wetland water quality occurred over 10 years ago on a 1300-acre golf resort project in central Guam.

On the issue of a "no net loss" policy, Guam has not established a formal permit and compliance tracking system of either the GLUC or U.S. Army Corps Section 404 systems to accurately determine policy compliance. Based on extensive knowledge of most wetland related permits and enforcement activities, the Agency believes that a significant number local actions have not included appropriate mitigation provisions. Furthermore, based on just gross application numbers for wetland type development, the Section 404 permit program has far out paced the GLUC system for the same projects. The Agency has limited involvement in U.S. Army Corps of Engineer mitigation projects at this time.

3.0. Development of Wetland Water Quality Standards

Interim wetland water quality standards, including coverage related to anti-degradation, were established in the 1992 amendments to the Guam Water Quality Standards by including wetlands in the definition of Guam Waters. Beneficial uses and narrative/numeric criteria for wetlands are issues Guam EPA would like to research and develop in the next triennial review of GWQS.

Under the Guam Water Quality Standards, the Agency's Section 401 WQC program is involved in a number of important ways to protect and monitor wetland resources. The following list highlights some of these provisions.

Requires wetland delineations (1987 U.S. ACE Manual)
Ecological evaluations
Environmental baseline surveys
Prohibited discharge statements
Mitigation policy statements
Public review and input

4.0. Integrity of Wetland Resources

Guam has not undertaken more than preliminary assessments of its wetland resources. There is no ongoing or formal program to examine wetland physical, biological, or chemical properties. The study conducted by WERI investigators in the Ugum Watershed did describe and examine preliminary functional attributes of a Palustrine-Riverine wetland system (Siegrist et al, 1996). Generally, the study confirms that wetlands are functionally important to overall water quality in the watershed by regulating and recycling trace metals, and nutrients and regulating sediment transport through the watershed. The study concludes and the Agency concurs that more study effort should be directed at Guam's tropical wetland systems to better understand the water quality implications of both disturbed and relatively undisturbed systems.

The attainment of uses generally, is another area lacking substantive investigation to date. The only observations and assumptions that might be offered are directly associated with known anthropogenic disturbances and impacts reported elsewhere. Assessments point to the fact that potential for accelerating erosion exists from activities such as poor construction practices, illegal and unimproved road development, including off-road activities, wild-land fires, unsustainable farming practices, and similar land disturbances. One of two assessments, the Ugum Watershed Resource Assessment (DeMeo, et al. 1995), examined water quality as affected by erosion. According to the assessment, the major sources of erosion are: (1) sheet and rill (2) road-surface, and (3) stream channel. Slope road erosion exhibits the highest rates within the watershed at 27 times the rate of soil loss from ravine forest areas. From 1975 to 1993 aerial photos document that the length of unimproved roads doubled in this watershed alone from 33.6 to 68.8 kilometers respectively. The Ugum Watershed is a high priority watershed with ongoing restoration efforts as guided by GWA non-point source and watershed management initiatives of the Guam Watershed Planning Committee. The Ugum Watershed is a critical source which can produce nearly 2 mgd of drinking water for several southern villages. There are no ongoing data collection efforts to compile and track the types and extent of stressors or sources of impairment other than those mentioned above.

5.0 Extent of Wetland Resources

As introduced in the opening chapter of this report, the 1983 National Wetland Inventory (NWI) identified just over 5,000 acres of fresh water wetlands including mangroves and excluding marine dominated systems (i.e., coral reefs and seagrass beds). This represents approximately 4% of the total island landmass and nearly all of the wetlands in Guam are located in the island's central and southern regions. The Bureau of Statistics and Plans developed a compilation map of the NWI and all of the official wetland delineation maps produced in the late 1980s to the mid 1990s. The Agency does maintain a comprehensive set (copies) of delineation maps produced since 1990.

6.0. Additional Wetland Activities

Wetlands and watershed protection must eventually be integrated. The Agency leads an inter-agency work group called the Watershed Planning Committee which evaluates and administers Section 319 funds for non-point restoration projects in accordance with five year restoration strategies. The bulk of surface water non-point source abatement and restoration efforts have centered on reforestation projects and public awareness of the Ugum Watershed. The Ugum Watershed Management Plan and supporting Watershed Resource Assessment provide an excellent basis for further integration at least in this watershed.

The major impediments to substantive integration and of wetlands into any major water quality program are programmatic in nature. Guam EPA is the lead entity for ensuring that wetland water quality is maintained and improved throughout the island. Much of this work has been shared with a number of resource agencies both federal and local. The Agency does not have direct permit system decision making authority except when

water quality certification is required for certain federal permits. Most the 404 permit projects are small and discrete construction events which can be managed accordingly. Some of the challenges (or needs) to broaden programmatic effectiveness are listed here.

Comprehensive inventory and data management
Local permit system reform, including legislation
Baseline biological and water quality studies
Public awareness
Comprehensive watershed planning

Having identified the issues, challenges and opportunities to advancing wetland resource protection specifically those aimed at the water quality components, the single most significant impediment to improvement is actually long term project management capacity. It is anticipated that several modest projects such as implementing a basic monitoring strategy, developing narrative criteria and designating uses could be accomplished at current resource levels. Long term projects and more focused leadership to oversee water quality studies will require additional personnel.

E. Trend Analysis For Surface Water

Trend analysis for surface water is not available for this report period.

F. Public Health and Aquatic Life Concerns

1.0 Drinking Water Supplies

Guam EPA Safe Drinking Water Program was established for the implementation and enforcement of the Guam Primary and Secondary Safe Drinking Water Regulations in accordance with the Safe Drinking Water Act.

The major objectives are to ensure the public of a continuous supply of safe water for the prevention and control of drinking water pollution, and to obtain full compliance with the Safe Drinking Water Act and the Memorandum of Agreement between Guam EPA and U.S EPA.

Testing has revealed that on occasion, both the Guam Waterworks Authority and the U.S. Navy failed to comply with the Safe Drinking Water Regulations for monitoring and reporting requirements, primarily for organic chemicals or for turbidity. However, the Andersen Air Force Base (AAFB) fully complies with Guam Safe Drinking Water Regulations. All other Public Water Suppliers monitored all the required parameters, and all were in compliance with the regulations.[7]

7 Angel B. Marquez, Guam EPA Safe Drinking Water Program Manager, Water Division

Ugum River and Ugum Water Treatment Plant

"Water quality in the Ugum River has declined in recent years as a result of human activities that have increased erosion and the resultant sedimentation in the streams and near shore waters. Off-road recreational vehicles, intentionally-set fires, and agricultural activities are the primary causes of the increased erosion and sedimentation. The increased sedimentation is considered especially significant in the Ugum watershed because the Ugum Water Treatment Plant is a primary source of drinking water in southern Guam. During the past several years the Treatment Plant has had to periodically shut down when suspended sediment at the intake reaches excessive levels. The treatment plant has been secured fifty two (52) times during the period of January 1 to December 31, 2004, lasting from two hours to twenty four hours duration at any given time. *The highest turbidity level at the intake (river) during the same period is 270 NTU and the average is 72 NTU. Also, during the following year, January 1 to December 2005, the treatment plant was secured thirty five (35) times due to high turbidity at the intake. The highest turbidity level during the same period is 3,018 NTU and the average is 516 NTU.* The increased sedimentation also contributes to poor quality in-stream aquatic habitats, a smothering of the coral reefs, and a decline in fish populations."[8]

Improvement in water quality to the Ugum River and to the Ugum Water Treatment Plant should occur with the implementation of the following activities:

- *Implementation of the Ugum River TMDL*

  Ugum River was delisted from Guam's 2006 303(d) list of waters that do not meet GWQS because a required Sediment TMDL was approved by EPA in 2006. The implementation of this plan should return the Ugum River into compliance with the GWQS or prevent a violation of water quality standards.

- *Rehabilitation of the Ugum Water Treatment Plant (UWTP)*

  In compliance with the GWA Stipulated Order for Preliminary Relief, GWA is required to undertake this project. Proposed projects at the treatment plant include the UWTP Membrane Filtration, UWTP Reservoir Replacement, and UWTP Raw Intake under the GWA Water Resources Master Plan.

- *Watershed Restoration Project*

  Tree planting projects in the Ugum watershed have been implemented under the leadership of local and federal agencies and supported by community groups. These projects have resulted in reducing erosion and run off, the conversion of badlands and grasslands into a forest, and the restoration of watershed segments affected by fire. These projects have also promoted environmental awareness about the destructive effects of fires and the positive impact of reforestation on water quality, wildlife habitat, and coral reefs. More restorative work is expected under the coordination of the Watershed Planning Committee.

8 Draft TMDL document for Ugum Watershed, Tetra Tech,Inc. and USEPA for Guam EPA (Aug. 2006)

2.0 Beach Use

Recreational Swimming Notifications

Guam EPA and the Department of Public Health and Social Services have joint authority regarding the closure of public beaches. West Hagatna Bay was closed in 2007 due to a sewage leak in the effluent pipe from the Hagatna Sewage Treatment Plant. Rizal Beach and the Lonfit River Swimming Hole sites were retired in 2007.

For calendar year 2006, 42 Tier 1 beaches were monitored for the U.S. EPA approved *enterococci* indicator, (weekly, year round). This resulted in approximately 2,196 samples analyzed per year and 604 swimming advisories issued.

In calendar year 2007, 42 Tier 1 beaches were monitored for the U.S. EPA approved *enterococci* indicator (weekly, year round). This resulted in approximately 2,182 samples analyzed per year and 601 swimming advisories issued. **(Refer to Tables B7a-c and B8a-c, Appendix B).**

Swimming advisories are issued based upon either an instantaneous concentration of 104 MPN/100mL or a geometric mean concentration of 35 MPN/100mL, over a five week period. All advisories are released and/or reported weekly, prior to the weekend, in local print, radio, and television media, to other local government agencies, private individuals, and posted on the Guam Environmental Protection Agency official web page. ***(http://guamepa.govguam.net).***

3.0 Consumption Concerns

3.1 Seaweed Consumption Advisories

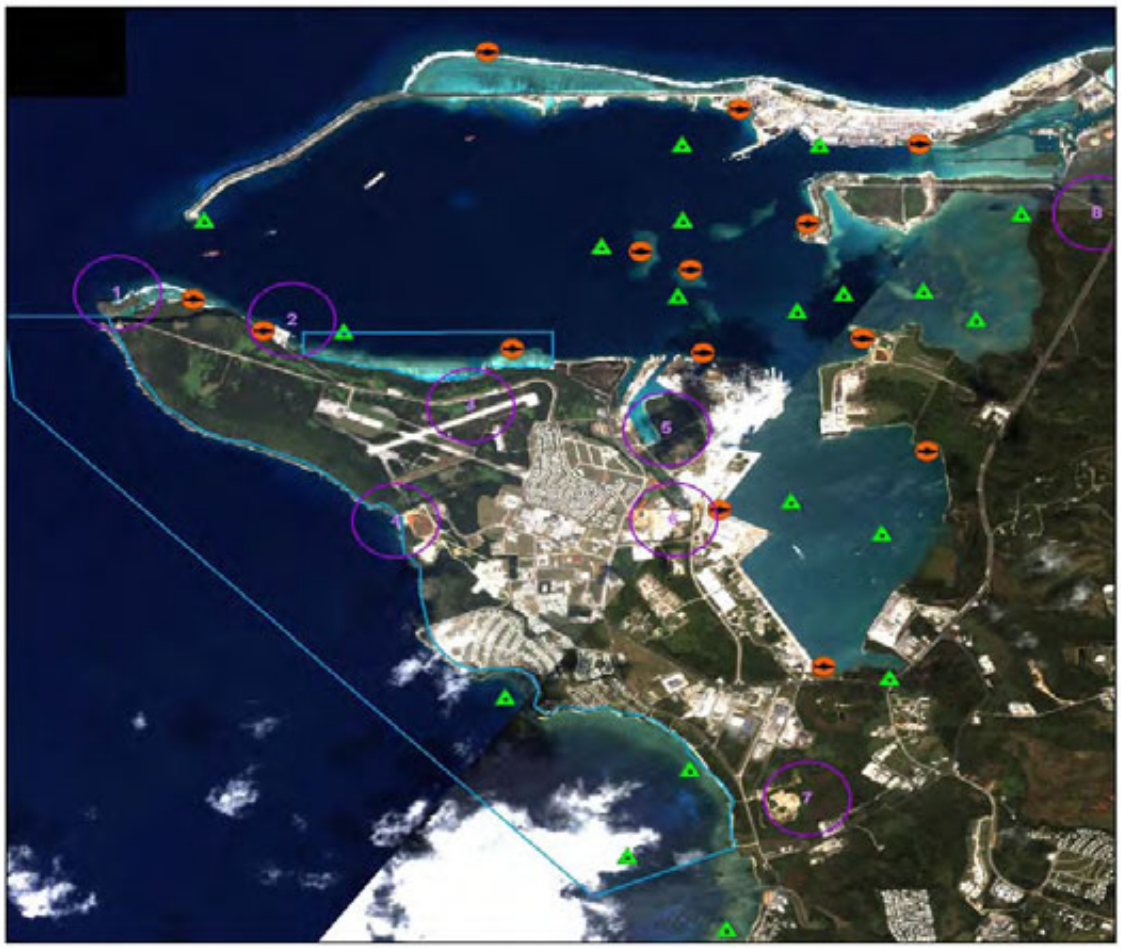
There has been a standing fish/seaweed consumption advisory for the Tanguisson Beach area since 1991. In that year, three people died and two more became ill after consuming seaweed, *Gracilaria tsudae,* collected from this beach. Samples of the seaweed were sent to Japan for toxicological analyses. It was determined that polycavernosides were the toxic agents responsible for the deaths and illnesses. The exact source of this toxic substance has yet to be identified. Therefore, this beach has been permanently included in Guam EPA's weekly advisories which warn the public to avoid the harvesting and consumption of seaweed, fish or marine organisms from this location.

3.2 Fish/Shellfish Consumption

There have been no reported cases of shellfish contamination from local harvests. Officially, there are no designated shellfish collection areas for the island of Guam. All historic shellfish areas have been decimated by either over harvesting or habitat loss. Newly created fish preserves are expected to allow local recovery of previously over harvested shellfish. Guam EPA is in the initial stages of implementing a fish/shellfish consumption program.

3.2.1 ***Orote Peninsula***

A seafood consumption advisory was issued in October 2001 by the Guam Department of Public Health for Agat Bay, based upon contaminated fishes located on the Orote peninsula. The consumption advisory remains in effect for the Orote peninsula and GabGab Beach (located on the Naval base). The consumption advisory was issued for all reef fish in this area due to elevated levels of polychlorinated biphenyls (PCBs), chlorinated pesticides, and/or dioxins.



Apra Harbor Fish Sampling[9]

Fish species from approximately 14 discrete sampling locations were collected from specific sites in both the inner and outer Apra Harbors on Guam. The whole body fish tissue was then subjected to chemical analysis to measure the concentration of a broad range of chemical contaminants of concern to Guam EPA. The general classification of contaminants sampled and analyzed for included pesticides, heavy metals, and a group of persistent organic pollutants - most notably the polychlorinated biphenyls or PCBs. Based upon the analytical results, human health risk estimates were then calculated based upon hypothetical consumption of those contaminated fish. The fish consumption rates (or amount of fish consumed per day) were based upon previous work that Guam EPA conducted to better understand the amounts and types of fish which are customarily consumed by village residents and subgroups living on Guam. The trends and risk estimates of the analysis thus far are extremely preliminary and subject to quality control confirmation. A map showing the advisory area is provided on the previous page..

3.2.2 ***Agana Swamp***

Fish Advisory in effect for the Agana Swamp is related to polychlorinated biphenyl (PCB) contamination from the Agana Power Plant (former U.S. Navy facility).

The US Navy conducted an investigation and cleanup of the Agana Power Plant located in Mongmong, Guam. This included the removal of PCB contaminated soil from the upland facility as well as the off site contaminated areas. Off-site contamination was found in storm water drainage areas, storm water outfall areas and associated slope leading into the Agana Swamp, and in the sediments of the Agana Swamp. A fish tissue investigation was conducted. Also during that time the U.S. military conducted tests to try and identify PCB sources to the Agana Swamp and river not related to the Agana Power Plant. That study identified Agana Springs as a possible PCB source.

The U.S. Navy, with environmental oversight from Guam EPA and USEPA via the BRAC process, removed all PCB contaminated soil and sediment associated with the Agana Power Plant activities. Based on the analysis of the fish tissue investigation, it was determined that a fish advisory should be implemented for the Agana Swamp in 2001 and that advisory remains in effect. A testing conducted by the Navy in October 2006 shows that some of the fish in the swamp and river are now testing higher for PCBs than back in 2000. The Navy and local officials have different opinions about why that occurred. The Navy has requested the U.S. Army Corps of Engineers to consider the Agana Springs site as a formerly used defense site to address further investigation and cleanup of PCBs in soil and sediment.

Meanwhile, the Navy has suggestions in place regarding the consumption of catfish and eel from the Agana Swamp area. The recommendation is that people can eat one fish per adult per month. No such recommendations exist for eating shrimp or snails or fruits and vegetables. Guam EPA DSMOA representatives note that there is a cancer risk because of the PCBs.

9 Information provided by Patrick Wilson, Ph.D., M.P.H., Senior Regional Toxicologist, USEPA R-9

3.2.3. Cocos Lagoon

In 2005 a fish advisory was issued after numerous fish samples tested positive for harmful PCBs. The fish consumption advisory remains in effect for fish caught in the Cocos Lagoon. Public Health epidemiologist Dr. Robert Haddock noted that theoretically there is some statistical risk of developing cancer, but probably very small. It would only occur in people that ate a lot of fish every week from this area. Officials did not feel there was enough information to close Cocos Lagoon to fishing as additional studies would be conducted to narrow down the geographic range that may be contaminated.

An environmental site investigation was conducted at the former U.S. Coast Guard (USCG) Long Range Navigation (LORAN) station at Cocos Island, Guam.[10] Potentially hazardous materials are believed to have been disposed in the vicinity of the former LORAN station during its operation in the years between 1944 and 1963. This investigation included assessment of soil, sediment, sea water, groundwater and biota in the vicinity of the site. This investigation was conducted as a follow-on investigation to the preliminary investigation conducted by Environet, Inc. (EI) in 2005.

Field work for this project was conducted between July 25 and August 15, 2006. The primary objective of this project was to further delineate polychlorinated biphenyl (PCB), metals and petroleum contamination at the former LORAN Cocos Island site in order to provide a more comprehensive evaluation of potential PCB, petroleum, and metals contamination in relevant matrices (soil, sediment, sea water, ground water and biota). The results of this investigation will be used to determine if additional characterization and remediation with regard to the former LORAN Cocos Island facilities is necessary to protect human health and the environment.

The following recommendations were provided in the report.

PCBs in Site Soils
It is recommended that the PCB-impacted soil (i.e. soil containing concentrations greater than the TSCA cleanup level of 1.0 mg/kg) be removed and/or treated in order to eliminate the potential PCB source from the site. Biota sampling indicated that PCBs were present in biota collected adjacent to the site and thus the impacted soils at the site could be a potential source of PCBs detected in the biota. [Action has been undertaken to remediate the PCB-impacted soil.]

PCBs in Biota Specimens
It is recommended that the USCG work with the GEPA to possibly modify the current fishing advisory placed on Cocos Lagoon based on the results of this report. It is also

10 *Final Report, Environmental Site Investigation, Former LORAN Station Cocos Island, Cocos Island, Guam.* Prepared by Element Environmental, LLC for the USCG under Contract No. HSCG86-06-R-6XA125.

recommended that additional biota specimens be collected from the near-shore area of the lagoon along the entire shoreline of Cocos Island from areas not previously sampled during this investigation or the preliminary investigation in order to expand on the biota data generated during this investigation and to further delineate the PCB-impacted biota.

TPH-diesel in Site Soils and Groundwater

Results of the investigation indicate that diesel is present in site soils and groundwater beneath the site. Additional soil and groundwater sampling and analysis are recommended in order to further delineate the extent of the diesel contamination, particularly in the area to the west southwest of Piezometer # 10 and #14 installed during this investigation.

IV. GROUND WATER MONITORING AND ASSESSMENT

A summary of Guam's ground water monitoring and protection programs, ground water quality, ground water contamination sources, and groundwater/surface water interactions is provided in this section. The EPA 1997 guidelines, *Section 5. Ground Water Assessment* were used to report ground water monitoring data per the 2006 IR Guidance.

A. Overview of Ground Water Contamination Sources

1.0 Hydrogeology

Guam is comprised of two sub-equally sized hydrogeologic provinces. In the southern half of the island, fresh groundwater occurs in weathered volcanic rock of low permeability, unconsolidated sediments within river drainages, and along the eastern coast's fringing limestone formations. The water table in the southern province reaches elevations of hundreds of feet above sea level in the volcanic rock and unconsolidated sediments. Other than a few springs, groundwater production in southern Guam is restricted to the narrow fringing limestone along the eastern coast, where the water table rarely reaches elevations greater than a few feet above sea level. Brackish to saline groundwater occurs along the southern and western coasts of the southern province within fractured limestone, artificial fill, and unconsolidated marine and estuarine sediments.

The northern half of the island is comprised of a limestone plateau bounded on the west, north and east by near-vertical cliffs and fringing reefs and on the south by the Adelup Fault that stretches from Adelup to Pago Bay. Groundwater in northern Guam is contained within the aquifer termed the "Northern Guam Lens" (NGL). This aquifer was designated a "principle source aquifer" in 1978 by the U.S. Environmental Protection Agency, and is essentially the groundwater source for the island. The aquifer is contained within a fractured carbonate complex ranging in age from Tertiary to Pleistocene (Tracey, 1962). The carbonate rock sequence has been significantly altered by tectonic and geochemical processes that have resulted in the formation of multiple stages of porosity and permeability. The resulting aquifer is therefore comprised of primary porosity and dissolution features of varying scale, both of which have been modified and/or enhanced by fracturing.

Guam's northern limestone plateau was deposited subaqueously as a result of down faulting along the Adelup fault and is underlain by nearly impermeable volcanic rock that is exposed at the surface in southern Guam. The limestone plateau reaches thicknesses of approximately 1000 feet and extends below sea level over most of its extent. As a result sea water has intruded into the island producing a layer of saltwater that overlies the volcanic rocks and extends into the limestone plateau. Guam's fresh groundwater is contained in a modified Ghyben-Herzberg lens system underlying most of northern Guam, having been formed by infiltrating rainfall that collected on top of the more dense saltwater. The NGL has been estimated to be capable of supplying 60 million gallons per day (60 MGD) of fresh water (Camp, Dresser, and McKee, 1982). The aquifer is divided into six sub-basins, containing 47 management zones (Camp, Dresser and McKee, 1982).

The NGL has been formed from surface recharge in northern Guam percolating through soils to the underlying limestone where it accumulates in a lens, which "floats" on and displaces the denser seawater. A recent study has documented the dynamics of fresh water lens response to short- and long-term recharge events. The study, to be published soon, is an attempt to more clearly define the percentage of recharge that remains in storage within the NGL and is available for production as drinking water. The moderate to high permeability of the limestone permits the ready flow of fresh water toward areas of discharge along the coast. Mixing of fresh and saltwater at the base of the lens produces a transition zone in which groundwater becomes progressively more saline downward and seaward.

Groundwater that occurs in the manner described above is called *"basal"* groundwater, and results in a water table that rarely exceeds approximately ten feet elevation. Most groundwater in the NGL is present under these conditions. Where infiltrating precipitation encounters the volcanic basement at elevations greater than approximately ten feet, the resulting groundwater rests upon the impermeable volcanic rock and *"parabasal"* conditions exist. Groundwater under these conditions can be produced without significant threat of salt water intrusion. The NGL is the selected aquifer for this assessment due to the abundance of excellent drinking water it contains, the large demand placed on the water from this unit, and its obvious vulnerability.

2.0 Sources of Ground Water Contamination

Table B9, Appendix B identifies the following ten contaminant sources as the greatest threat to Guam's ground water quality. "Professional judgment" was used to complete the respective table. Each source of groundwater contamination is associated with factors considered in its selection and a contaminant(s).

- **animal feedlots**
- **fertilizer applications**
- **pesticide applications**
- **underground storage tanks**
- **landfills**
- **septic systems/cesspools**
- **hazardous waste generators**
- **pipelines and sewer lines**
- **salt water intrusion**
- **urban runoff**

The two most common factors considered in the selection of these contaminant sources were human health and/or environmental risk (toxicity) and location of the sources relative to drinking water sources. The common contaminant in six of the ten sources was "nitrate".

2.1 "Protecting and Restoring Guam's Waters" – *water resources protection and restoration, and pollution prevention approach*

In September 1999 Guam EPA documented its overall approach for managing water resources on Guam. This document, entitled *"Protecting and Restoring Guam's Waters"*, identified the most significant threat to Guam's water quality as **development without adequate infrastructure support.** It further stated that such development "leads to a high density of septic systems over a high permeability substrate, an insufficient and poorly maintained sewage treatment system, erosion problems from poorly managed construction projects, groundwater well over-production, and groundwater impacts from inadequate environmental practices of poorly managed light industries."

This document identified its list of on-island sources of water pollutants which included:

- inadequate domestic waste water treatment (sewage treatment plants and septic tanks/leaching fields) contributing to elevated levels of bacteria and nitrates in our groundwater;
- urban storm water runoff, particularly in the north, contributing to nutrients in our near shore waters;
- unconfirmed sources contributing to elevated levels of TCE and TCA (solvents and degreasers), PCE (dry cleaners and degreasers); thallium (insecticides); and EDB (pesticides) in groundwater;
- aquaculture facilities and golf courses contributing to elevated nutrients and pesticide levels;
- accidental spills of pollutants and hazardous materials from sites with inadequate spill prevention control countermeasure plans;
- leaking above and under ground storage tanks and associated pipelines;
- construction without adequate erosion and sediment control measures;
- wildfires, and off-road vehicle use, particularly evident in the south, causing excess siltation, turbidity and sedimentation;
- leachate from landfills and agricultural runoff;
- past activities on military sites;
- recreational water craft, including jet-skis, which are damaging marine life; and
- inadequate enforcement.

The only difference between these two lists (of sources of water pollutants) was "salt water intrusion".

B. Overview of Guam's Ground Water Protection Program

Guam EPA manages different environmental programs which serve to protect ground water resources. Most programs are fully established but undergo continuous revision based on changes in statutes or regulations or to maintain effective control measures. **Table B10, Appendix B** summarizes the status of ground water protection programs in Guam. Related information is available at www.guamepa.govguam.net. Information about Guam's key ground water protection programs are presented in the following.

1.0 Northern Guam Lens Study

It has been long recognized that the NGL supply needed protection and in 1978 the groundwater lens in northern Guam was defined as a "sole source aquifer," by the EPA Administrator under Section 1424(e) of the Safe Drinking Water Act (SDWA).

In order to properly protect this "sole source aquifer", it was necessary to define the range or extent of the aquifer, the types of protection and/or controls needed, and the type of management system needed to monitor, control, develop, and protect this resource.

In 1979 Guam EPA initiated the Northern Guam Lens Study (NGLS), which was completed in December 1982. This study sufficiently defined the range or extent of the aquifer and the types of protection and/or controls needed. It also outlined the framework necessary for Guam EPA to implement the type of management system needed to monitor, control, develop, and protect this resource. This 21-year old study is still in use.

The Northern Lens Study concluded the following:

a. The aquifer and its recharge areas cover almost the entire northern half of the island and are divided into six major sub-basins based on the volcanic subsurface topography. These sub-basins are further divided into 47 management zones, which could provide an estimated sustainable yield of 59 million gallons a day.

b. The lens contains very high quality water but needs to be protected against both contamination from percolation of surface pollution through the very permeable soils and salt-water intrusion due to over-pumping of the lens.

c. The management system defines the necessary data to be collected, construction practices, the operation and maintenance practices needing modification, and the required legislative and legal measures that should be developed to properly implement the program.

2.0 Ground Water Legislation, Statutes, Rules, and/or Regulations

The statutory authority for water resources management programs fall under the provisions of 10 GCA, Chapter 46 (Water Resources Conservation Act). This and other pertinent rules and/or regulations can be found at www.guamepa.govguam.net/regs/index.html.

Public Law 24-247 provides matching funds to continue river gauging and the performance of salinity monitoring and water level measurements within the lens by the Department of Interior, USGS Water Data Management Program for Guam.

The Guam Hydrologic Survey Program (GHS) was mandated by the 24th Guam Legislature in October, 1997. Under the program, WERI has been charged with the responsibility to consolidate, inventory, and evaluate all of the current and historical hydrologic data pertaining to Guam. WERI is also responsible for establishing and maintaining a permanent data library for instant data access and retrieval.

3.0 Wellhead Protection Program

Provisions for wellhead protection were adopted as part of the reauthorization of the Safe Drinking Water Act (SDWA), signed into law in June 1986. The legislation established a nationwide program to encourage states to develop systematic and comprehensive programs within their jurisdiction. Such programs were intended to protect water supply wells and well fields from all sources of anthropogenic contamination. Program submittals to EPA were due by June 19, 1989. Wellhead protection regulations have been revised as recently as March 4, 1993.

4.0 Underground Injection Control (UIC) Well and UIC Permitting Program

The only type of injection well in Guam is the Class V well used primarily for drainage of storm water runoff. All injection wells in Guam have been issued permits and are inspected annually. At present, there are two hundred ninety-four (294) permitted wells. The breakdown of ownership is as follows:

1.	Andersen Air Force Base (USAF)	103
2.	Guam International Airport Authority (GovGuam)	31
3.	Department of Public Works (GovGuam)	46
4.	Guam Power Authority (GovGuam)	2
5.	University of Guam (GovGuam)	1
6.	Pacific Island Club (Private)	1
7.	Atkins Kroll (Toyota)	10
8.	Teleguam Holding, Inc. (GTA)	6
9.	Nissan Motors	3
10.	Mobil Oil Guam	6
11.	Other private permittees	85

The Guam EPA's Water Resources Management Program conducts annual compliance inspections to

- verify if the site or location of injection wells conform with its operating permit requirements and conditions;
- assure adequate maintenance of the wells to prevent groundwater contamination; and
- identify discrepancies or deficiencies between the inspected well and its permitted requirements and conditions.

A UIC permit is required for anyone who has constructed a well used primarily for drainage of storm water runoff. The permit provides a means of tracking all injection wells and insuring, through inspection, that such wells are properly maintained. Recent concern has developed over the proliferation and extensive use, in the last 10 years, by commercial establishments to contain stormwater runoff within its boundaries. These drainage systems, because of their configuration and purpose, are now considered injection wells requiring a UIC permit.

4.1 Underground Injection Control Monitoring

Guam EPA's UIC program has a Permit-driven water quality monitoring requirement for UIC well/system owners. As of September 2005, there were 34 UIC well owners operating a total of 294 individual wells/systems. With the exception of one UIC owner, the remaining UIC wells/systems are located over the northern Guam lens.

Table 24. UIC Sampling Parameters

	Chemical	MCL (mg/l)		Chemical	MCL (mg/l)
1.	MBAS	0.5	11.	Lead	0.015
2.	Oil and Grease*	N/D	12.	Benzene	0.005
3.	NO_3-N	10.0	13.	Ethylbenzene	0.7
4.	Endrin	0.002	14.	Xylene	10.0
5.	Lindane	0.0002	15.	Toluene	1.0
6.	Toxaphene	0.003	16.	Boron	5.0
7.	2, 4-D**	0.07	17.	COD	50.0
8.	2, 4, 5 -TP Silvex***	0.05	18.	pH	6.5-8.5
9.	Heptachlor	0.0004	19.	MTBE	0.02
10.	Methoxychlor	0.04			

* Not Detected using 0.05 ppm MDL. ** 2,4 - Dichlorophenoxyacetic Acid
MCLs are based on the most current Guam Water Quality Standards.

The UIC well/system owners are required to perform water quality monitoring sampling semiannually on 19 chemicals. The owners are required to grab the first set of samples during the first significant rainfall between the months of April and July which represent the end of the dry season and the onset of the rainy season. This sampling event is scheduled during this period as a way of capturing the illusive *first flush*. The second set of samples is grabbed between the months of October and December which are the last three months of the rainy season. The 19 chemicals of concern and their respective MCLs are listed in **Table 24.**

5.0 Ground Water Assessment Monitoring

An ambient ground water monitoring system has been established for Guam ground water under Guam EPA. Pump rates and chloride concentrations of all production wells are currently being monitored. Guam EPA has been attempting to establish a monitoring well network that would allow the Agency to monitor lateral and vertical salinity trends within the aquifer.

This assessment monitoring program is an annual evaluation of groundwater chemical, physical and yield characteristics to track trends within the Northern Aquifer – the principal potable water supply resource for the island. The program is a judgmental sampling design which incorporates a sampling frequency based on Guam's two index periods. The sampling frequency is one sample event per production well (Total of 110) per index period, resulting in a total of 220 samples per calendar year for each resource unit. Resource units are then rotated through a four year cycle.

The first index period on Guam is a dry season, which occurs from January through June. The island's wet season, July through December, makes up the second index period.

The goal of this program is specifically to provide the Guam EPA with baseline water quality data, to characterize and define trends in the, chemical, physical and yield conditions of the island's primary groundwater supply. It is also designed to identify new or existing water quality problems and to act as a triggering mechanism for focused studies, investigations, inspections and enforcement, or other appropriate actions by the Agency.

The specific objectives of this program are to:
1) Identify, document and predict the conditions of Guam's water resources; assist in determining the status of the aquifer's "environmental health".
2) Document potential problem areas;
3) Identify water quality changes over time in aquifer subbasin water bodies;
4) Provide information to managers, legislators, agencies and the public;
5) Determine the proportion of the state's water bodies that meet water quality criteria.

To meet its environmental goals and objectives, this program integrates a combination of chemical, physical, and yield indicators to monitor and assess site specific water quality conditions and aquifer long term water quality trends.

The general list of Indicators is listed below, with a complete list in **Table C5, Appendix C.**

- General water chemistry (chlorides, nitrates)
- Organic and Inorganic Constituents
- Physical Parameters (Water Level, Yields)

Another component of this plan is the Production Well chemical monitoring required as part of the Safe Drinking Water permits for a Public Water Supply System (PWSS). The schedule on the previous page, see **Table 25**, is an example for Organic and Inorganic Monitoring preformed by the PWSSs. This data is also used to track trends and provide data for more detailed investigations.

6.0 Man-Made Impoundment Monitoring

The Man-Made Impoundment Monitoring Plan primarily evaluates chemical data sampled from man-made impoundments very much like the UIC plan. **Table 26** presents the locations and schedule for surface impoundment (i.e. ponding basins) sampling. At present, this plan focuses on surface impoundment impacts to groundwater. This plan will be extended to the surface impoundments of Southern Guam that affect surface water quality of receiving streams and other water bodies.

Table 25. Groundwater Source & Water Distribution System: Organic & Inorganic Sampling Schedule

2006	GWA/Earth Tech Production Wells	GWA Water Distribution System
1st Quarter	A-1, A-2, A-3, A-4, A-5, A-6	Agana Heights Mayor's Office
2nd Quarter	D-2, D-3, D-4, D-5, D-6, D-7	GWA Laboratory, Dededo
3rd Quarter	F-2, F-3, F-4, F-5 F-6, F-7	Northern District Sewage Treatment Plant
4th Quarter	M-12, M-14, M-15, M-17a, M-17b, M-18	Mangilao Mayor's Office
2007	**GWA/Earth Tech Production Wells**	**GWA Water Distribution System**
1st Quarter	A-7, A-8 A-9, A-10, A-11, A-12	Sinajana Mayor's Office
2nd Quarter	D-8, D-9, D-10, D-11, D-12, D-13	Merizo Mayor's Office
3rd Quarter	F-8, F-9, F-10, F-11, F-12, F-13	Finegayan Elementary School
4th Quarter	M-20a, M-21, M-22, M-23, MJ-1, MJ-5	Inarajan Middle School
2008	**GWA/Earth Tech Production Wells**	**GWA Water Distribution System**
1st Quarter	A-13, A-14, A-15, A-17, A-18, A-19	Piti Mayor's Office
2nd Quarter	D-14, D-15, D-16, D-17, D-18, D-19	Umatac Mayor's Office
3rd Quarter	F-15, F-16, F-17, F-18, F-19, F-20	Tamuning Mayor's Office
4th Quarter	NAS-1, Y-1, Y-2, Y-3, Y-4, Y-5	Santa Rita Spring
2009	**GWA/Earth Tech Production Wells**	**GWA Water Distribution System**
1st Quarter	A-21, A-23, A-25, A-26, A-28, A-29	Barrigada Mayor's Office
2nd Quarter	D-20, D-21, D-22a, D-23a, D-24, D-25	Agueda Johnston Middle School
3rd Quarter	GH-501, H-1, HGC-2, M-1, M-2, M-3	Toto Mayor's Office
4th Quarter	Y-6, Y-7, Y-9, Y-10, Y-12, Y-14	Yigo Mayor's Office
2010	**GWA/Earth Tech Production Wells**	**GWA Water Distribution System**
1st Quarter	A-30, A-31, A-32, AG-1, AG-2a, D-1	Asan Mayor's Office
2nd Quarter	D-26, D-27, D-28, EX-5a, EX-11, F-1	Yona Mayor's Office
3rd Quarter	M-4, M-5, M-6, M-7, M-8, M-9	Talofofo Elementary School
4th Quarter	Y-15, Y-17, Y-18, Y-19, Y-20, Y-21a, Y-22	Upi Elementary School, Yigo

Table 26. Man-Made Impoundment Area WQM Schedule.

Cycle	SLA Name	Site No.	Location	Cycle Sampling Year	Plus One Site Each from Other Four Cycles
I	GHURA 501	43	Behind Dededo Transfer Station	2006	2007
	Potts Junction	12	Rte 9; 500 Feet West of Well HGC-3	2006	2008
	Marianas Terrace	36A	Gaynero Street, Yigo	2006	2009
	Airport road Extension	72A	Route 10A (South Side)	2006	2010
II	GHURA 502	20	Route 3 (Astumbo Gardens)	2007	2006
	Ypaopao Estates	42B	Behind PUAG Pump Station	2007	2008
	Hatsuho Golf Course	12E	Route 3 (Near Club House)	2007	2009
	Harmon Sinkhole	71	Route 10A (Near Hotel Mai'Ana)	2007	2010
III	Agana Hts. Injection Wells	79	F. Xavier Dr./Salamon Dr., Agana Hts	2008	2006
	Guam Community College	76A	Sesame Street, Mangilao	2008	2007
	GHURA 503	15	Route 3 (Fern Terrace)	2008	2009
	Guam Intl. Airport Terminal	72	Route 10A (Across Airport Parking Lot)	2008	2010
IV	Barrigada 76 Gas Station	74	Route 10 & Route 8 Intersection	2009	2006
	GHURA 35	48B	Near Northern Public Health Center	2009	2007
	Macheche Subdivision	55A	Macheche Avenue, Dededo	2009	2008
	GHURA 505	41	Atsadas Street, Yigo	2009	2010
V	Sinajana Baseball Field	79B	Chalan Guma' Yuus, Sinajana	2010	2006
	Latte Heights	56A	Gardenia Ave. & Carnation Ave.	2010	2007
	GHURA 506	38	Near Simon Sanchez High School	2010	2008
	Dededo Public Park	47A	Rte. 1 & Ysengsong Rd. Intersection	2010	2009

C. Summary of Ground Water Contamination Sources

The top ten contaminant sources presenting the greatest threat to Guam's ground water quality were identified earlier in this section and reference can be made to related contaminant information in **Table B9, Appendix B.** Guam EPA includes the following narrative on major contaminant sources and groundwater locations most at risk on Guam.

1.0 Septic Systems

Significant portions of developed areas on Guam do not have sewers, particularly in

Northern and Central Guam above the Northern Guam Lens (designated as a sole source aquifer). Lack of wastewater collection in these developed areas is endangering the integrity of the NGL.

2.0 CERCLA Sites Overlying the NGL

There are three CERCLA sites, which overlie the NGL: Andersen Air Force Base (AAFB), Tiyan (the former Naval Air Station, Agana), and the Navy Construction Battalion (CB) Landfill .

Andersen Air Force Base was listed on the National Priority List (NPL) in October 1992. Groundwater beneath the site has been investigated in accordance with the Federal Facility Agreement (FFA) since that time. Prior to NPL listing, groundwater was investigated under the Department of Defense, Installation Restoration Program (DoD, IRP) beginning in 1986.

Groundwater beneath Tiyan has been investigated since 1986 under the DoD, IRP. Groundwater contamination beneath Tiyan has been detected in the form of TCE and PCE. One production well (NAS-1) exists on the former base and a water sample collected in January 1991 exceeded the MCL for TCE. Subsequent groundwater sampling of monitoring wells under the BRAC has shown the presence of an extensive area of contamination of PCE and TCE. Contamination in NAS-1 is currently being remediated through wellhead treatment through activated carbon filtration. GIAA has plans to install four (4) production wells on Tiyan. If these wells become impacted by the TCE/PCE contamination plume, GIAA will conduct wellhead treatment with activated carbon filtration.

The Navy Construction Battalion (CB) Landfill continues to be investigated under the Navy's IR Program. It is currently being monitored with no signs of groundwater contamination. Closure of the CB Landfill has been completed which included the placement of a non-permeable cap as a presumptive remedy under the CERCLA process. Groundwater contaminants have been detected in site monitoring wells but remained below action levels for six sampling rounds. Hydraulic communication between the site and a down gradient freshwater pond (which is used for swimming and shrimp harvesting) and coastal springs has been established. Long-term monitoring has been modified to exclude and close all site monitoring wells and include down gradient coastal springs. The final Record of Decision (ROD) for the site is currently under evaluation.

3.0 AAFB Main Base TCE Ground Water Contamination - Building 18006

Building 18006 has been operational since the 1960's. AAFB started looking at this site after its status was converted from an Area Of Concern (AOC) to an Installation Restoration (IR) site in the beginning of CY 2005. This was done to access funding to start an investigation into whether Building 18006 may be contributing to the groundwater TCE contamination

The facility is currently being looked at as a "potential site" for TCE contamination based upon groundwater sampling results from IRP wells 3, 39, 50, and USGS-150 and the fact that the facility is located up-gradient of the wells in addition to historic knowledge that the facility used TCE . A 1970 report with photos revealed discharge(s) of TCE into a UIC well.

Test borings have been drilled to evaluate the subsurface conditions around Building 18006. However, as it currently stands, there has been no "smoking gun" found yet to implicate Bldg. 18006 as the source of TCE contamination in the groundwater on AAFB main base. AAFB will be developing the physical scenario with all the information gathered as this investigation moves forth.

4.0 Air Force Marbo Groundwater Impacted by TCE and PCE

The groundwater table beneath the Andersen Air Force Base MARBO Annex ranges from approximately 281 to 400 feet below ground surface. There are water production wells within the MARBO Annex area. This water is blended with water from other production wells and is distributed to various villages. As a consequence of past Air Force activities at MARBO Annex, the groundwater beneath the Annex area has been impacted by trichloroethylene (TCE) in the northern portion and tetrachloroethene (PCE) in the vicinity of the former MARBO Laundry facility. This contamination was first detected in MARBO groundwater when appropriate groundwater sampling and analysis was initiated some 30 years ago. As a result, Andersen Air Force Base has been identified as the responsible party for the groundwater contamination and has since implemented some actions to address the situation.

AAFB's selected alternative for the MARBO Annex Groundwater is *Monitored Natural Attenuation with Institutional Controls* to achieve the remediation goal of decreasing trichloroethylene (TCE) and tetrachloroethene (PCE) concentrations in the aquifer to levels below Maximum Contaminant Levels (MCLs). The timeframe to achieve this cleanup goal is 45 years or maybe even longer based upon uncertainties of the total mass of TCE/PCE that may exist in the subsurface. However, the levels of TCE/PCE at shallow depth appear to be responding at a very slow rate to natural attenuation in contrast to the concentrations at deeper depths which continue to show no significant change. *Natural Attenuation* of the TCE and PCE in the groundwater is expected to occur primarily as a result of the physical processes of dispersion and dilution and not of biochemical dechlorination processes.

In a letter to AAFB (dated Jan 12, 2006), Guam EPA stated that based upon groundwater sample results, there has been no significant decline in the TCE concentrations at depth and that *Natural Attenuation* is not an effective remediation strategy. Therefore, Guam EPA recommends that AAFB not rely solely on *Natural Attenuation*, but rather seek other treatment technologies to accelerate the breakdown of the TCE in the groundwater. To date, the levels of contamination continue to persist with groundwater sample results showing very little change. Guam EPA has identified three alternative treatment options that have been demonstrated to be effective in reducing concentrations of chlorinated

organic contaminants in groundwater. Andersen Air Force Base is now evaluating each option to determine which is best to address the MARBO groundwater TCE/PCE contamination. Guam EPA's position is that to leave untreated chlorinated solvents in a sole-source drinking water aquifer for an estimated 75 years is unacceptable.

As a side note, the Long-Term Groundwater Monitoring Program (LTGM) was initiated in October 1995 with the goal of:

- Continuing to expand the baseline groundwater data at monitoring and production wells,
- Continue evaluating baseline data and identifying critical sampling locations,
- Installing new monitoring wells, and
- Determining modifications to monitoring points, monitoring frequency, and analytical methods.

The institutional controls that are in place include:

- Land Use Restrictions to monitor and restrict groundwater access from areas impacted by TCE/PCE,
- Groundwater Monitoring to continue tracking the TCE/PCE contaminant plumes, and
- Planning for Wellhead Treatment, or discontinue production from wells found to be contaminated to ensure that there is no public health risk at existing Air Force production wells.

5.0 Ground Water Conditions in the Vicinity of the Orote "Landfill"

The Orote "Landfill" was an uncontrolled Navy dump throughout its operational history. Contaminants initially detected in soil and buried waste at the facility include PCBs, dioxins (including 2,3,7,8 TCDD) and furans, polychlorinated aliphatic hydrocarbons, volatile organic compounds (including TCE, PCE, TCA, DCA, and BTEX), metals, and pesticides. These same contaminants have also been detected in groundwater in monitoring wells in and around the dump, coastal fresh water springs and marine waters, and marine sediments and organisms (including fish).

In 2001 the beach area immediately adjacent to the dump was cleaned up of metallic debris, a sea wall was constructed to minimize further erosion of contaminated soil and buried waste, and an impermeable cap was constructed over the dump in an attempt to isolate contaminated waste from the groundwater and marine water beneath and adjacent to the dump.

Subsequent sampling of groundwater, spring and marine waters, and off-shore biota indicate that the contaminants persist in the local environment. A study of the effects of storm-induced waves, tides, and heavy rains on the water table in the vicinity of the capped dump has demonstrated that groundwater rises into buried waste and probably remobilizes contaminants thought to have been isolated from the groundwater and marine environment by the cap and seawall. It was also determined that storms cause temporary

reversals of the water table and groundwater flow direction, thus continuing to disperse contaminants away from the dump through the groundwater pathway.

Continued investigations and discussions with the U.S. Navy are ongoing to determine what actions are required to ensure protection of human health and the environment.

6.0 Other CERCLA Sites

There are several CERCLA sites located in the Southern Guam hydrogeologic province not over the NGL: the Ordot Landfill and numerous sites belonging to the Navy.

The Ordot Landfill is listed on the NPL, but no groundwater contamination resulting from activities at the site has been documented. However, leachate impacts to the Lonfit River have been documented and it is suspected that the Lonfit River is in hydraulically connected with the southern-most extension of the NGL. Therefore, impacts to the NGL from Ordot leachate are possible.

The Navy sites are being addressed by Naval Forces Marianas (formerly NAVACTS, FISC, SRF, and NCTAMS), and Navy Public Works Center, Guam. The following sites are currently being addressed by the Navy under their IR program:

USS Proteus Fire Fighting Training Area (fuel contamination);
PWC Building 3009 PCB Remediation (PCB contamination);
Orote Point Dump, (PCB contamination)
Area Behind Fenceline, SRF (PCB's, PAH's, metals);
Dry Cleaning Shop (metals, fuels, PAH's)
Tenjo Vista Abandoned Pipeline (fuel contamination); and
Lower Sasa Fuel Burning Pond (fuel and solvent contamination).

The Navy is also addressing several other sites under their RCRA program. These sites include:
Orote Power Plant (diesel fuel contamination);
Sasa Fuel Storage Tanks (diesel fuel contamination);
Tenjo Vista Storage Tanks (diesel fuel contamination);
PWC Landfill; and
Old DRMO PCB Remediation

These sites are all located above the coastal brackish and saline waters characteristic of the Apra Harbor area. Collectively, these sites may contribute to groundwater degradation, and therefore, it is recommended that the sites be periodically evaluated as new data becomes available.

Recently, it has been determined that PCBs have gotten into the food chain off shore from the Orote Landfill site. The source(s) of the PCBs has yet to be determined. However, PCBs as well as other chemicals are present in buried material at the landfill, which makes the site a potential source. Therefore, monitoring wells and other sampling

techniques are planned to confirm or deny the Orote Landfill as a source of the contamination.

Building 3009 (Navy facility), located on COMNAVMAR, Guam, was used for electrical transformer maintenance from 1952 through 1977. Contaminated soil was removed from the site, but upon confirmation sampling it was determined that additional PCB contamination persists. The contamination was identified within the location of Building 3009 as well as the storm water drainage swales leaving the site. The investigation establishes a pathway of contamination that lead to Inner Apra Harbor via the storm water swales. The US Navy will conduct an additional removal of the contaminated soil as well as investigation of Inner Apra Harbor.

D. Summary of Ground Water Quality

The overall ground water quality of the NGL is good, however, it is significantly vulnerable to contaminants, including chloride contamination induced from over pumping of water supply wells. These threats increase the NGL's contamination potential.

During the last quarter of 2005 Guam EPA under the lead of its Safe Drinking Water Program, investigated requirements of "Ground Water Under the Direct Influence of Surface Water" because of the contamination of several GWA ground water wells and possibly U.S. Navy wells. Staff suspected that these wells were potentially influenced by surface water or raw sewage from leaking sewer pumps or sewer pipes. The Agency has formulated draft guidance to determine the source if the groundwater is under the influence of surface water.

The preservation of the Northern Guam Lens Aquifer is a priority because of its designation as Guam's Sole Source Aquifer and because of the magnitude of incidences observed in which the levels of pollutants (Bacteria, Nutrients, Chlorides, and Toxic Contaminants) exceeded Guam Water Quality Standards. The Agency will facilitate assessment, planning, or pollution control activities necessary to improve water quality such that it complies with local standards. The degree of public interest in or concern about the water body is extremely high.

Guam's aquifer is the main source of Guam's potable water supply. Two Air Force wells (Tumon Maui and MW-1), one Navy well (NAS-1) and one GWA well (F8) have been closed in recent years because of toxic contaminants, while a few wells have increasing chloride levels from saltwater intrusion. Two private wells (Guam Plaza Hotel) have shown TCE concentrations above Safe Drinking Water levels.

- TCE is found in solvents and degreasers. Guam Waterworks Authority's NAS-1 well came into violation for high levels of TCE in March 1995 and was shut down. A granular activated carbon filter was installed at the wellhead and it was placed in operation in August 1997 to remediate the groundwater.

- PCE is used in the dry cleaning industry and is also found in degreasers. In 1996, the Air Force's Tumon Maui well came into violation of the Safe Drinking Water

Standards when PCE was detected above the Maximum Contaminant Level (MCL) of 5 µg/l, with concentrations of 10.8 µg/l in October 1995, 8.58 µg/l in November 1995, and 8.0 µg/l in December 1995. The well was shut off until an air stripper was installed at the Booster Pump Station No. 2 and was placed in operation in January 1997 to remediate the groundwater at Tumon Maui and AAFB production well MW-1. In July 1997, AAFB informed Guam EPA that the air stripper was taken off-line for maintenance and operation would resume in approximately 30 days. However, the Air Force decided that maintenance procedures were too complicated compared with the need for groundwater production and to date the wells remain shut down.

- EDB is found in fumigants, pesticides and leaded gasoline. However, EPA suspended the use of EDB fumigant in 1983, and the use of leaded gasoline in cars was gradually discontinued beginning in the late 1970s. In 1996, GWA water samples taken from its F-8 well exceeded the EDB, TCE, TCE, and MTBE MCLs. Well F-8 was shut down in October of 1996 (when final test results were received). Carbon filtration has being installed at the wellhead for F-8, and the well is back in operation. The source of contamination of F-8 is, as of yet, unknown.

- Two production wells were installed at the Guam Plaza Hotel (GPH) located in Tumon, near the Tumon Maui well in 1997. Beginning with the first water samples collected from the wells in December 1997, PCE and TCE have been detected. Since then, TCE has exceeded Safe Drinking Water standards in well GPH-1 and in well GPH-2. The hotel was given the option to apply for an operator's permit to include the installation of a treatment system to remove the contaminants or to shut the wells down. The hotel opted to install the treatment system and has been operating their wells under this compliance order. Monitoring reports indicate that the wells are producing water which meets water quality standards. However, Guam EPA will be evaluating the effectiveness of Guam Plaza Hotel's well compliance monitoring activities during the next reporting period. The results of this assessment will determine if it is necessary for the Hotel to continue operating their wells under the current compliance order.

Gasoline from a leaking underground storage tank (LUST) was discovered when an old underground storage tank was being removed from a former Exxon service station in 1998. A total of fourteen (14) monitoring wells were installed to delineate the extent of the plume. A potable GWA well, approximately 700 feet from the LUST has never had a detection of petroleum product. Remediation of the well consists of four (4) pumps and treat wells, six (6) soil vapor extraction (SVE) wells and five (5) sparge wells. The SVE system is very effective in the cleanup/removal of the contaminants. While the pump and treat wells are rather ineffective, they have been kept in operation to keep the plume from migrating to the potable well.

E. Summary of Groundwater-Surface Water Interactions

Guam EPA has a growing awareness of ground water-surface water interactions and their contribution to water quality problems.

Another aspect of groundwater is spring discharge along the coast in the inter- and sub-tidal zones. These springs comprise the discharge of the NGL aquifer. A recently completed study has characterized the chemistry of discharge from selected springs into Tumon Bay. The study consisted of sampling eight Tumon Bay springs during four discrete sampling events. Total discharge estimated for the seven springs is 17 million gallons per day.

A two-year study of spring water discharge into Tumon Bay has been completed. The study was funded with Clean Water Action Plan money through the Watershed Planning Committee and consisted of four sample rounds of eight springs along the Bay during both the wet and dry seasons. Chemicals detected above Guam EPA water quality standards included Tetrachlorethene, Trichloroethene, Aluminum, Antimony, Arsenic, Magnesium, Chloride, Sulfate, Oil & Grease, Total Coliform and Fecal Coliform. Pesticides Dieldrin, Alpha-Chlordane, and Gama Chlordane were also detected in spring discharge. However no Guam EPA water quality standards currently exist for these compounds. Impacts from the chemicals on Tumon Bay are planned to be mitigated by locating and eliminating sources of the chemicals.

Efforts will continue to be made in the evaluation and interpretation of groundwater – surface water interactions.

The Northern Watershed (and therefore the NGL) is designated by the Watershed Planning Committee as one of the priority watersheds targeted for the development and implementation of a restoration strategy.